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U. S. DEPARTMENT OF AGRICULTURE  
BIOLOGICAL SURVEY—BULLETIN No. 35

H. W. HENSHAW, *Chief*

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DISTRIBUTION AND MIGRATION OF  
NORTH AMERICAN SHOREBIRDS

BY

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*Assistant, Biological Survey*



WASHINGTON  
GOVERNMENT PRINTING OFFICE  
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31

## LETTER OF TRANSMITTAL

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U. S. DEPARTMENT OF AGRICULTURE,  
BIOLOGICAL SURVEY,  
*Washington, D. C., June 22, 1910.*

SIR: I have the honor to transmit herewith, for publication as Bulletin No. 35 of the Biological Survey, a report on the Distribution and Migration of North American Shorebirds, by Wells W. Cooke, assistant, Biological Survey. Many species of shorebirds inhabit the United States or pass through our territory in migration. These birds possess considerable economic importance, and as other wild game like ducks, geese, and swans diminish in numbers their value for food and as a means for sport will increase. Large numbers are annually killed, and unless prompt measures are taken adequately to protect them some of the larger and more important kinds are likely to become extinct, especially in the region east of the Mississippi River. A knowledge of the summer and winter abodes of the several species and of the routes they take in migration is essential to intelligent legislation in their behalf, and, accordingly, all the known facts in regard to this part of their life history are here brought together.

Respectfully,

H. W. HENSHAW,  
*Chief, Biological Survey.*

Hon. JAMES WILSON,  
*Secretary of Agriculture.*

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# DISTRIBUTION AND MIGRATION OF NORTH AMERICAN SHOREBIRDS.

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## INTRODUCTION.

Shorebirds form a valuable national resource, and it is the plain duty of the present generation to pass on to posterity this asset undiminished in value. Consistent and intelligent legislation in favor of any group of birds must be founded on extended, accurate information, and must include knowledge of the breeding and distribution of the birds—where they spend the summer, whither they retire in winter, and when and by what routes they migrate. The present bulletin supplies this needed information so far as it is now available.

Consideration of our shorebirds (*Limicolæ*) from an economic point of view is recent. The early settlers found ducks, geese, and swans swarming in certain sections of the United States, and grouse and turkeys very abundant. The size and toothsome-ness of these birds made them important objects of pursuit for food, while the shorebirds were considered unworthy of notice. As the great flocks of ducks and geese along the Atlantic coast diminished in numbers, the attention of gunners, especially of market hunters, was turned to the shorebirds, then in countless numbers. A generation of constant harassment spring and fall has almost exterminated some of the larger species and has very greatly reduced even the smaller ones. The time has come when this indiscriminate slaughter must cease if the present remnant of the shorebirds is to be preserved.

The range of our shorebirds extends from ocean to ocean, so that all parts of the United States have an interest in their preservation. These birds feed naturally in the open country or along the open shore, where they are easily found and are constantly subject to attack. The prairies of the Mississippi Valley in past years formed the great highway of spring migration. Flock followed flock in almost endless succession across the prairies of Kansas, Nebraska, and the Dakotas, over a region that of late years has passed under the plow. As this area becomes more densely populated the shorebirds, once so abundant, are likely to become extinct unless active measures are taken for their preservation.

There are excellent reasons for protecting and preserving the shorebirds. Some of them, especially the several kinds of plovers,

perform important service in destroying noxious insects. The flesh of many of them, even of the smaller kinds, has a high food value, and some of the larger species—the upland, golden, and black-bellied plovers, and the curlews—were in the times of their abundance important articles of diet. Their pursuit for sport, when they are shot over decoys, demands a high degree of skill, and is a favorite pastime of many hunters. Nor should the esthetic side of the question be ignored. The graceful forms and motions of these birds as they feed at the edge of the breakers are an interesting sight to thousands of seashore visitors. The silencing of their melodious calls would be a loss to every lover of nature. Finally, it may be said in their favor that not one of the shorebirds ever does any harm, while many have proved of great value to agriculture. Their accounts have only a credit side.

The shorebirds are among the most widely distributed of all birds. As far to the northward as man has found land shorebirds breed, while in winter they visit the tropical and Antarctic shores. The distances traversed in their migrations probably average greater than those of any other family, and the shorebirds probably exceed all others in the number of miles traveled in a single flight.

#### DISTRIBUTION.

The shorebirds are represented in North America by 76 species and 9 subspecies, a total of 85 recognized forms; but the following 7 of these do not range so far north as the United States:

##### SOUTHERN SPECIES NOT RANGING NORTH TO THE UNITED STATES.

Rufous-naped plover ( <i>Ochthodromus wilsonius rufinuchus</i> ).	Cayennelapwing ( <i>Hoploxypterus cayanus</i> ).
Stone curlew ( <i>Edicnemus bistratus</i> ).	Azara ring plover ( <i>Ægialitis collaris</i> ).
Colombian jacana ( <i>Parra melanopygia</i> ).	Santo Domingo killdeer ( <i>Oxyechus vociferus torquatus</i> ).
Black jacana ( <i>Parra nigra</i> ).	

There remain 78 species and subspecies that occur in the United States and northward, but 5 of these are found only in Greenland, as follows:

##### EUROPEAN SPECIES OCCURRING IN NORTH AMERICA ONLY IN GREENLAND.

European snipe ( <i>Gallinago gallinago</i> ).	Golden plover ( <i>Charadrius apricarius</i> ).
Black-tailed godwit ( <i>Limosa limosa</i> ).	Oyster-catcher ( <i>Hæmatopus ostralegus</i> ).
Whimbrel ( <i>Numenius phæopus</i> ).	

Fifteen other species from the Eastern Hemisphere are known as stragglers on the mainland of North America:

##### STRAGGLERS IN NORTH AMERICA FROM THE EASTERN HEMISPHERE.

European woodcock ( <i>Scolopax rusticola</i> ).	Red-shank ( <i>Totanus totanus</i> ).
Great snipe ( <i>Gallinago media</i> ).	Green sandpiper ( <i>Helodromas ocropus</i> ).
Long-toed stint ( <i>Pisobia damacensis</i> ).	Wood sandpiper ( <i>Rhyacophilus glareola</i> ).
Dunlin ( <i>Pelidna alpina</i> ).	Ruff ( <i>Pavoncella pugnax</i> ).
Curlew sandpiper ( <i>Erolia ferruginea</i> ).	Lapwing ( <i>Vanellus vanellus</i> ).
Spoon-bill sandpiper ( <i>Eurynorhynchus pygmeus</i> ).	Dotterel ( <i>Eudromias morinellus</i> ).
Green-shank ( <i>Glottis nebularia</i> ).	Little ringed plover ( <i>Ægialitis dubia</i> ).
	Mongolian plover ( <i>Ægialitis mongola</i> ).

Deducting these, there are 58 species of shorebirds that belong to the regular avifauna of North America north of Mexico. Not all of these, however, occur in the United States. The sharp-tailed sandpiper is a regular migrant through Alaska, but is not found elsewhere in North America. The Pacific godwit, bristle-thighed curlew, and Pacific golden plover breed in Alaska and migrate thence to Asia and the Pacific islands. The ringed plover breeds in northeastern North America and migrates to Europe. The turnstone breeds in both northeastern and northwestern Arctic America, but migrates to Europe, Asia, and the Pacific islands without coming regularly to the United States; while the Aleutian and the Pribilof sandpipers both breed and winter in Alaska. A further deduction of these 8 species leaves 50 species which regularly visit the United States during some part of the year.

The shorebirds as a group are far northern breeders. The majority of them breed in the region of the Arctic Circle, and several range north to the known limits of land. The majority do not breed so far south as the United States, and hence are known there only as migrants, or in the winter season.

#### SPECIES THAT BREED WHOLLY NORTH OF THE UNITED STATES.

Red phalarope (*Phalaropus fulicarius*).  
 Northern phalarope (*Lobipes lobatus*).  
 Dowitcher (*Macrorhamphus griseus*).  
 Long-billed dowitcher (*Macrorhamphus griseus scolopaceus*).  
 Stilt sandpiper (*Micropalama himantopus*).  
 Knot (*Tringa canutus*).  
 Purple sandpiper (*Arquatella maritima*).  
 Aleutian sandpiper (*Arquatella maritima covesi*).  
 Pribilof sandpiper (*Arquatella maritima pilocnemis*).  
 Sharp-tailed sandpiper (*Pisobia aurita*).  
 Pectoral sandpiper (*Pisobia maculata*).  
 White-rumped sandpiper (*Pisobia fuscicollis*).  
 Baird sandpiper (*Pisobia bairdi*).  
 Least sandpiper (*Pisobia minutilla*).  
 Red-backed sandpiper (*Pelidna alpina sakhalina*).  
 Semipalmated sandpiper (*Ereunetes pusillus*).  
 Western sandpiper (*Ereunetes mauri*).  
 Sanderling (*Calidris leucophaea*).

Pacific godwit (*Limosa lapponica baueri*).  
 Hudsonian godwit (*Limosa hæmastica*).  
 Greater yellow-legs (*Totanus melanoleucus*).  
 Yellow-legs (*Totanus flavipes*).  
 Wandering tattler (*Heteractitis incanus*).  
 Buff-breasted sandpiper (*Tryngites subruficollis*).  
 Hudsonian curlew (*Numenius hudsonicus*).  
 Eskimo curlew (*Numenius borealis*).  
 Bristle-thighed curlew (*Numenius tahitiensis*).  
 Black-bellied plover (*Squatarola squatarola*).  
 Golden plover (*Charadrius dominicus*).  
 Pacific golden plover (*Charadrius dominicus fulvus*).  
 Semipalmated plover (*Egialitis semipalmata*).  
 Ringed plover (*Egialitis hiaticula*).  
 Surf bird (*Aphriza virgata*).  
 Turnstone (*Arenaria interpres*).  
 Ruddy turnstone (*Arenaria interpres marinella*).  
 Black turnstone (*Arenaria melanocephala*).

#### SPECIES THAT BREED IN BOTH THE UNITED STATES AND CANADA.

Wilson phalarope (*Steganopus tricolor*).  
 Avocet (*Recurvirostra americana*).  
 Woodcock (*Philohela minor*).  
 Wilson snipe (*Gallinago delicata*).  
 Marbled godwit (*Limosa fedoa*).  
 Solitary sandpiper (*Helodromas solitarius*).  
 Western solitary sandpiper (*Helodromas saklarius cinnamomeus*).  
 Willet (*Catoptrophorus semipalmatus*).

Western willet (*Catoptrophorus semipalmatus inornatus*).  
 Upland plover (*Bartramia longicauda*).  
 Spotted sandpiper (*Actitis macularia*).  
 Long-billed curlew (*Numenius americanus*).  
 Killdeer (*Oryzochus vociferus*).  
 Piping plover (*Egialitis melodia*).  
 Black oyster-catcher (*Hæmatopus bachmani*).

## SPECIES THAT DO NOT BREED NORTH OF THE UNITED STATES, WITH NORTHERN LIMIT OF BREEDING RANGE.

- |   |   |
|---|---|
| Black-necked stilt ( <i>Himantopus mexicanus</i> ), Oregon. | Oyster-catcher ( <i>Hematopus palliatus</i> ), South Carolina.  |
| Snowy plover ( <i>Ægialitis nivosus</i> ), Nevada.          | Frazar oyster-catcher ( <i>Hematopus frazari</i> ), California. |
| Wilson plover ( <i>Ochthodromus wilsonius</i> ), Virginia.  | Mexican jacana ( <i>Jacana spinosa</i> ), Texas.                |
| Mountain plover ( <i>Podasocys montanus</i> ), Montana.     |   |

## SPECIES THAT BREED CHIEFLY NORTH OF THE ARCTIC CIRCLE, WITH THE NORTHERN-MOST LATITUDE AT WHICH THE SPECIES HAS BEEN OBSERVED IN THE WESTERN HEMISPHERE.

- |  |  |
|--|--|
| Red phalarope ( <i>Phalaropus fulicarius</i> ), 82°.                     | Sanderling ( <i>Calidris leucophæa</i> ), 82°.                     |
| Northern phalarope ( <i>Lobipes lobatus</i> ), 74°.                      | Hudsonian godwit ( <i>Limosa hæmastica</i> ), 69°.                 |
| Long-billed dowitcher ( <i>Macrorhamphus griseus scolopaceus</i> ), 71°. | Buff-breasted sandpiper ( <i>Tryngites subruficollis</i> ), 71°.   |
| Stilt sandpiper ( <i>Micropalama himantopus</i> ), 69°.                  | Hudsonian curlew ( <i>Numenius hudsonicus</i> ), 69°.              |
| Knot ( <i>Tringa canutus</i> ), 83°.                                     | Eskimo curlew ( <i>Numenius borealis</i> ), 69°.                   |
| Purple sandpiper ( <i>Arquatella maritima</i> ), 74°.                    | Black-bellied plover ( <i>Squatarola squatarola</i> ), 71°.        |
| Pectoral sandpiper ( <i>Pisobia maculata</i> ), 71°.                     | Golden plover ( <i>Charadrius dominicus</i> ), 77°.                |
| White-rumped sandpiper ( <i>Pisobia fuscicollis</i> ), 69°.              | Pacific golden plover ( <i>Charadrius dominicus fulvus</i> ), 65°. |
| Baird sandpiper ( <i>Pisobia bairdi</i> ), 71°.                          | Semipalmated plover ( <i>Ægialitis semipalmata</i> ), 75°.         |
| Least sandpiper ( <i>Pisobia minutilla</i> ), 70°.                       | Ringed plover ( <i>Ægialitis hiaticula</i> ), 78°.                 |
| Red-backed sandpiper ( <i>Pelidna alpina sakhalina</i> ), 72°.           | Turnstone ( <i>Arenaria interpres</i> ), 83°.                      |
| Semipalmated sandpiper ( <i>Ereunetes pusillus</i> ), 71°.               | Ruddy turnstone ( <i>Arenaria interpres morinella</i> ), 74°.      |

## SPECIES THAT BREED IN BOTH EASTERN AND WESTERN HEMISPHERES.

- |  |   |
|--|---|
| Red phalarope ( <i>Phalaropus fulicarius</i> ).    | Black-bellied plover ( <i>Squatarola squatarola</i> ).        |
| Northern phalarope ( <i>Lobipes lobatus</i> ).     | Pacific golden plover ( <i>Charadrius dominicus fulvus</i> ). |
| Knot ( <i>Tringa canutus</i> ).                    | Ringed plover ( <i>Ægialitis hiaticula</i> ).                 |
| Purple sandpiper ( <i>Arquatella maritima</i> ).   | Turnstone ( <i>Arenaria interpres</i> ).                      |
| Sanderling ( <i>Calidris leucophæa</i> ).          |   |
| Pacific godwit ( <i>Limosa lapponica baueri</i> ). |   |

## SPECIES THAT WINTER IN THE UNITED STATES AND SOUTHWARD.

- |   |  |
|---|--|
| Avocet ( <i>Recurvirostra americana</i> ).                          | Spotted sandpiper ( <i>Actitis macularia</i> ).          |
| Black-necked stilt ( <i>Himantopus mexicanus</i> ).                 | Long-billed curlew ( <i>Numenius americanus</i> ).       |
| Woodcock ( <i>Philohela minor</i> ).                                | Black-bellied plover ( <i>Squatarola squatarola</i> ).   |
| Wilson snipe ( <i>Gallinago delicata</i> ).                         | Killdeer ( <i>Oryzochus vociferus</i> ).                 |
| Dowitcher ( <i>Macrorhamphus griseus</i> ).                         | Semipalmated plover ( <i>Ægialitis semipalmata</i> ).    |
| Long-billed dowitcher ( <i>Macrorhamphus griseus scolopaceus</i> ). | Piping plover ( <i>Ægialitis melodia</i> ).              |
| Purple sandpiper ( <i>Arquatella maritima</i> ).                    | Snowy plover ( <i>Ægialitis nivosus</i> ).               |
| Least sandpiper ( <i>Pisobia minutilla</i> ).                       | Wilson plover ( <i>Ochthodromus wilsonius</i> ).         |
| Red-backed sandpiper ( <i>Pelidna alpina sakhalina</i> ).           | Mountain plover ( <i>Podasocys montanus</i> ).           |
| Semipalmated sandpiper ( <i>Ereunetes pusillus</i> ).               | Ruddy turnstone ( <i>Arenaria interpres morinella</i> ). |
| Western sandpiper ( <i>Ereunetes mauri</i> ).                       | Black turnstone ( <i>Arenaria melanocephala</i> ).       |
| Sanderling ( <i>Calidris leucophæa</i> ).                           | Oyster-catcher ( <i>Hematopus palliatus</i> ).           |
| Marbled godwit ( <i>Limosa fedoa</i> ).                             | Frazar oyster-catcher ( <i>Hematopus frazari</i> ).      |
| Greater yellow-legs ( <i>Totanus melanoleucus</i> ).                | Black oyster-catcher ( <i>Hematopus bachmani</i> ).      |
| Yellow-legs ( <i>Totanus flavipes</i> ).                            | Mexican jacana ( <i>Jacana spinosa</i> ).                |
| Western willet ( <i>Catoptrophorus semipalmatus inornatus</i> ).    |  |

## SPECIES THAT DO NOT WINTER NORTH OF SOUTH AMERICA.

Red phalarope ( <i>Phalaropus fulicarius</i> ).	Solitary sandpiper ( <i>Helodromas solitarius</i> ).
Northern phalarope ( <i>Lobipes lobatus</i> ).	Western solitary sandpiper ( <i>Helodromas solitarius cinnamomeus</i> ).
Wilson phalarope ( <i>Steganopus tricolor</i> ).	Upland plover ( <i>Bartramia longicauda</i> ).
Stilt sandpiper ( <i>Micropalama himantopus</i> ).	Buff-breasted sandpiper ( <i>Tryngites sub-ruficollis</i> ).
Knot ( <i>Tringa canutus</i> ).	Eskimo curlew ( <i>Numenius borealis</i> ).
Pectoral sandpiper ( <i>Pisobia maculata</i> ).	Golden plover ( <i>Charadrius dominicus</i> ).
White-rumped sandpiper ( <i>Pisobia fusci-collis</i> ).	Surf bird ( <i>Aphriza virgata</i> ).
Baird sandpiper ( <i>Pisobia bairdi</i> ).	
Hudsonian godwit ( <i>Limosa hæmastica</i> ).	

The three following species winter in the West Indies or Central America and southward, but are not found at this season in the United States: Willet (*Catoptrophorus semipalmatus*), wandering tattler (*Heteractitis incanus*), and Hudsonian curlew (*Numenius hudsonicus*). The purple sandpiper (*Arquatella maritima*) remains in winter as far north as Greenland and does not range south of the United States; while the Aleutian sandpiper (*Arquatella maritima couesi*) and the Pribilof sandpiper (*Arquatella maritima pilocnemis*) do not occur in winter south of Alaska.

## SPECIES THAT RANGE SOUTH IN WINTER TO SOUTH AMERICA, WITH THE SOUTHERN LIMIT OF THE WINTER RANGE.

Red phalarope ( <i>Phalaropus fulicarius</i> ), Falkland Islands.	Yellow-legs ( <i>Totanus flavipes</i> ), Strait of Magellan.
Northern phalarope ( <i>Lobipes lobatus</i> ), Peru and probably farther.	Solitary sandpiper ( <i>Helodromas solitarius</i> ), Argentina.
Wilson phalarope ( <i>Steganopus tricolor</i> ), Falkland Islands.	Western solitary sandpiper ( <i>Helodromas solitarius cinnamomeus</i> ), not known.
Black-necked stilt ( <i>Himantopus mexicanus</i> ), Peru.	Willet ( <i>Catoptrophorus semipalmatus</i> ), Peru.
Dowitcher ( <i>Macrorhamphus griseus</i> ), Brazil.	Upland plover ( <i>Bartramia longicauda</i> ), Argentina.
Long-billed dowitcher ( <i>Macrorhamphus griseus scolopaceus</i> ), probably Peru.	Buff-breasted sandpiper ( <i>Tryngites sub-ruficollis</i> ), Argentina.
Stilt sandpiper ( <i>Micropalama himantopus</i> ), Uruguay.	Spotted sandpiper ( <i>Actitis macularia</i> ), Peru.
Knot ( <i>Tringa canutus</i> ), Tierra del Fuego.	Hudsonian curlew ( <i>Numenius hudsonicus</i> ), Chile.
Pectoral sandpiper ( <i>Pisobia maculata</i> ), Argentina.	Eskimo curlew ( <i>Numenius borealis</i> ), Patagonia.
White-rumped sandpiper ( <i>Pisobia fusci-collis</i> ), Tierra del Fuego.	Black-bellied plover ( <i>Squatarola squatarola</i> ), Peru.
Baird sandpiper ( <i>Pisobia bairdi</i> ), Chile.	Golden plover ( <i>Charadrius dominicus</i> ), Argentina.
Least sandpiper ( <i>Pisobia minutilla</i> ), Chile.	Semipalmated plover ( <i>Ægialitis semipalmata</i> ), Argentina.
Semipalmated sandpiper ( <i>Ereunetes pusillus</i> ), Patagonia.	Snowy plover ( <i>Ægialitis nivosa</i> ), Chile.
Western sandpiper ( <i>Ereunetes mauri</i> ), Venezuela.	Surf bird ( <i>Aphriza virgata</i> ), Chile.
Sanderling ( <i>Calidris leucophaea</i> ), Argentina.	Ruddy turnstone ( <i>Arenaria interpres morinella</i> ), Chile.
Hudsonian godwit ( <i>Limosa hæmastica</i> ), Strait of Magellan.	Oyster-catcher ( <i>Hæmatopus palliatus</i> ), Chile.
Greater yellow-legs ( <i>Totanus melanoleucus</i> ), Strait of Magellan.	

## SPECIES THAT OCCUR IN THE UNITED STATES ONLY AS MIGRANTS, BREEDING IN THE FAR NORTH AND WINTERING TO THE SOUTHWARD.

Red phalarope ( <i>Phalaropus fulicarius</i> ).	Hudsonian godwit ( <i>Limosa hæmastica</i> ).
Northern phalarope ( <i>Lobipes lobatus</i> ).	Buff-breasted sandpiper ( <i>Tryngites sub-ruficollis</i> ).
Stilt sandpiper ( <i>Micropalama himantopus</i> ).	Hudsonian curlew ( <i>Numenius hudsonicus</i> ).
Knot ( <i>Tringa canutus</i> ).	Eskimo curlew ( <i>Numenius borealis</i> ).
Pectoral sandpiper ( <i>Pisobia maculata</i> ).	Golden plover ( <i>Charadrius dominicus</i> ).
White-rumped sandpiper ( <i>Pisobia fusci-collis</i> ).	Surf bird ( <i>Aphriza virgata</i> ).
Baird sandpiper ( <i>Pisobia bairdi</i> ).	

## SUMMARY.

Species that do not breed north of the United States.....	7
Species breeding in the United States and Canada.....	15
Total species breeding in the United States.....	22
Species breeding wholly north of the United States.....	36
Species breeding north of and wintering in the United States.....	15
Species breeding or wintering in the United States.....	37
Species occurring in the United States as migrants only.....	13
Total species occurring in the United States.....	50
Species occurring regularly in Arctic America, but not in the United States...	8
Total species occurring regularly in North America north of Mexico.....	58
European species straggling to Greenland.....	5
Eastern Hemisphere species straggling to North America.....	15
Southern species not ranging north to the United States.....	7
Total species and subspecies in North America.....	85

## MIGRATION.

The shorebirds as a group are among the most wide ranging of migrants. While a few, for example the jacanas, do not migrate at all, most shorebirds migrate more than a thousand miles each season, and many lengthen their journeys to 7,000 miles. The most wonderful feature of their migration is the enormous distance covered in a single flight. As explained in the account of the golden plover, many flocks of plover fly without resting from Nova Scotia to northern South America, a distance of about 2,500 miles. Many individuals of other species perform the same flight, notably the Eskimo curlew, while in the case of the Hudsonian godwit and the upland plover the principal place of departure in fall migration is the coast of the United States north of Virginia, and many of the flocks make stops in the Lesser Antilles on their way to South America.

That the same route is employed by other species is shown by the large number of shorebirds annually visiting the Bermudas. These islands lie about 800 miles off the coast of South Carolina and are in a nearly direct line from southern Nova Scotia to the Lesser Antilles. Years ago, when shorebirds were far more numerous than now, many flocks stopped at the Bermudas in fall migration. The most common species were the pectoral, white-rumped, least, and semipalmated sandpipers, the sanderling, greater yellow-legs, lesser yellow-legs, solitary sandpiper, spotted sandpiper, Hudsonian curlew, semipalmated plover, turnstone, and Wilson snipe. All of these came in sufficient numbers to show that their visits were not accidental, and evidently they had merely paused a few days on their journey to the Lesser Antilles. The killdeer appeared regularly in November and

remained through the winter, but since this species scarcely goes north of New England, the individuals wintering on the Bermudas must have visited the islands for the purpose of remaining there through the cold season. Specimens of eleven other species of shorebirds have been taken in the Bermudas. They are less common visitors, and most of these individuals were probably on their way across the ocean to the Lesser Antilles.

This route, however, is not followed by these species in their return in the spring, and there seems to be no evidence as yet that any species of shorebird migrates regularly in the spring across the ocean from the Lesser Antilles to the coast of New England or to eastern Canada. Indeed, shorebirds migrating north in spring through the Lesser Antilles are almost unknown.

Along the Atlantic coast shorebirds are many times more numerous in fall than in spring, while in the Mississippi Valley there is no such pronounced difference of numbers at the two seasons. This fact, taken in connection with the rarity of all species of shorebirds during the spring migration in the West Indies, where they are abundant fall visitors, seems to indicate that in the case of most of the species of shorebirds that migrate south in fall along the Atlantic coast some individuals pass northward in spring by way of the Mississippi Valley. The Eskimo curlew used to follow this route, as still do most of the golden plover. The statement applies also largely to the long-billed dowitcher, stilt, white-rumped, and semipalmated sandpipers, and the lesser yellow-legs. This elliptical migration route is in the case of most species not less than 6,000 miles in its north and south diameter, nor less than 2,000 miles east and west, while the winter home of the white-rumped sandpiper is 9,000 miles from its breeding grounds.

The Hawaiian Islands lie in the Pacific Ocean 2,000 miles from the nearest mainland to the eastward and more than 3,000 miles from the Asiatic coast. The nearest point of Alaska is about 2,000 miles north. Five species of shorebirds that summer in Alaska are found in the Hawaiian Islands during the winter season. They are the turnstone, Pacific golden plover, sanderling, bristle-thighed curlew, and wandering tattler. There is every reason to believe that these Hawaiian birds come from Alaska and that they make the 2,000-mile trip at a single flight. All of these species occur farther south in Oceania, but there seems to be no evidence that any of them use the Hawaiian Islands as a stopping place on the way to a more southern home. Apparently all the birds that fly to the Hawaiian Islands remain there through the winter, while the southern islands of Oceania are populated by individuals that have migrated along the Asiatic coast. It is remarkable that in the case of both the turnstone and the plover the first individuals to arrive on the Hawaiian Islands in the fall are in good condition or even fat, while the curlew and plover

that reach the Lesser Antilles by a long flight over the Atlantic Ocean are reported as emaciated.

Shorebirds present some idiosyncrasies of migration that are worthy of mention. The sharp-tailed sandpiper (*Pisobia aurita*) breeds on the northern coast of Siberia, and in fall migration crosses to Alaska and then back again to Asia and by way of Japan and China reaches its winter home in Australia. The most eastern point of its range in Alaska—Norton Sound—is some 500 miles east of its summer home in Siberia. As the species is not known in Alaska in spring, its migration route is probably elliptical, and the northern route in spring is probably across the mainland of Asia.

Some individuals of the marbled godwit (*Limosa fedoa*) have a unique migration route. From their breeding grounds in North Dakota and Saskatchewan some of these birds formerly migrated almost directly east more than a thousand miles to the Atlantic coast, while others traveled a thousand miles due west to the coast of southern Alaska.

Some birds breed in the Western Hemisphere and winter in the Eastern. For example, the Pacific godwit (*Limosa lapponica baueri*) breeds on the western shores of Alaska, whence it passes by way of the Commander Islands, Japan, and China to its winter home in Australia. The bristle-thighed curlew (*Numenius tahitiensis*) follows a somewhat similar route. The wandering tattler (*Heteractitis incanus*) breeds in Alaska and some individuals pass in fall migration to Asia, Hawaii, and Oceania, while others continue down the American coast to the Galapagos.

A long migration route from the eastern side of North America is followed by the ringed plover (*Ægialitis hiaticula*). Some individuals breed in Greenland and still farther west in Ellesmere Land and about Cumberland Sound, whence they pass east and southeast to the European coast and winter from the Mediterranean to southern Africa.

Both these last routes are used by the turnstone (*Arenaria interpres*). The individuals that breed in Greenland and Ellesmere Land migrate southeast to Europe and Africa, while those that breed in Alaska, even as far east as Point Barrow, migrate to the west and southwest to winter in Asia and Oceania.

Another migration route, probably unique, is that taken by the considerable numbers of the mountain plover (*Podasocys montanus*) that winter in the Sacramento Valley and elsewhere in California. The farthest west and north that the species is known to breed is Montana; hence whether the California wintering birds come from Montana or from the more southern districts, they apparently form an exception to the general rule that North American birds do not winter farther west than they breed.

Though many of the shorebirds breeding in North America winter in the southern part of South America, none of them breed in their

winter home. Special attention needs to be called to this fact, because nearly a dozen species of this family—among which may be noted particularly the greater and lesser yellow-legs and the white-rumped sandpiper—have been reported as breeding near the southern end of South America. In no case has it been claimed that the eggs have been found, and all the records are based on the finding of young not fully grown or in most cases simply from the presence of individuals during the usual breeding season of local species. This latter reason is not even presumptive of breeding. Nearly a hundred species of North American birds escape the winter of the Northern Hemisphere by visiting South America, and they remain there through what is the breeding season of the resident species, but do not themselves undertake any household cares. It may be stated positively that none of the Limicolæ that breed north of the equator breed also in the southern part of their range.

**SPECIES THAT ARE REGULAR MIGRANTS SPRING AND FALL ON THE ATLANTIC AND THE PACIFIC COASTS AND IN THE INTERIOR.**

American avocet ( <i>Recurvirostra americana</i> ).	Spotted sandpiper ( <i>Actitis macularia</i> ).
Wilson snipe ( <i>Gallinago delicata</i> ).	Black-bellied plover ( <i>Squatarola squatarola</i> ).
Least sandpiper ( <i>Pisobia minutilla</i> ).	Killdeer ( <i>Oxyechus vociferus</i> ).
Greater yellow-legs ( <i>Totanus melanoleucus</i> ).	Semipalmated plover ( <i>Ægialitis semipalmata</i> ).

**SPECIES THAT ARE REGULAR MIGRANTS SPRING AND FALL ON BOTH THE ATLANTIC AND THE PACIFIC COASTS, BUT ARE RARE OR WANTING IN THE INTERIOR.**

Red phalarope ( <i>Phalaropus fulicarius</i> ).	Hudsonian curlew ( <i>Numenius hudsonicus</i> ).
Northern phalarope ( <i>Lobipes lobatus</i> ).	Ruddy turnstone ( <i>Arenaria interpres morinella</i> ).
Red-backed sandpiper ( <i>Pelidna alpina sakhalina</i> ).	
Sanderling ( <i>Calidris leucophæa</i> ).	

**SPECIES THAT ARE REGULAR MIGRANTS SPRING AND FALL ON THE ATLANTIC COAST AND IN THE INTERIOR, BUT ARE RARE OR WANTING ON THE PACIFIC COAST.**

Woodcock ( <i>Philohela minor</i> ).	Solitary sandpiper ( <i>Helodromas solitarius</i> ).
Knot ( <i>Tringa canutus</i> ).	Piping plover ( <i>Ægialitis meloda</i> ).
Pectoral sandpiper ( <i>Pisobia maculata</i> ).	

**SPECIES THAT ARE REGULAR MIGRANTS SPRING AND FALL ON THE PACIFIC COAST AND IN THE INTERIOR, BUT ARE RARE OR WANTING ON THE ATLANTIC COAST.**

Wilson phalarope ( <i>Steganopus tricolor</i> ).	Long-billed curlew ( <i>Numenius americanus</i> ).
Long-billed dowitcher ( <i>Macrorhamphus griseus scolopaceus</i> ).	
Western willet ( <i>Catoptrophorus semipalmatus inornatus</i> ).	

**SPECIES THAT OCCUR IN MIGRATION PRINCIPALLY ON THE PACIFIC COAST.**

Black-necked stilt ( <i>Himantopus mexicanus</i> ).	Snowy plover ( <i>Ægialitis nivosa</i> ).
Western sandpiper ( <i>Ereunetes mauri</i> ).	Surf bird ( <i>Aphriza virgata</i> ).
Western solitary sandpiper ( <i>Helodromas solitarius cinnamomeus</i> ).	Black turnstone ( <i>Arenaria melanocephala</i> ).
Wandering tattler ( <i>Heteractitis incanus</i> ).	Black oyster-catcher ( <i>Hæmatopus bachmani</i> ).

**WESTERN SPECIES THAT COME EAST IN MIGRATION TO THE ATLANTIC COAST.**

Wilson phalarope ( <i>Steganopus tricolor</i> ).	Baird sandpiper ( <i>Pisobia bairdi</i> ).
Long-billed dowitcher ( <i>Macrorhamphus griseus scolopaceus</i> ).	Western sandpiper ( <i>Ereunetes mauri</i> ).

The data on the breeding and wintering of the shorebirds has been collated from all available printed sources, from the manuscript reports of the field naturalists of the Biological Survey, and from the specimens and catalogues of the United States National Museum. The dates of migration have been obtained principally from the migration schedules sent in by the several hundred observers in the United States and Canada, who for a quarter of a century have contributed to the Biological Survey spring and fall reports of their observations. It is a pleasure to testify to the earnest and conscientious efforts these observers have put forth for the solving of some of the phases of Nature's great migration problem and to return thanks to them for their painstaking labors.

#### NORTH AMERICAN SHOREBIRDS.

##### Red Phalarope. *Phalaropus fulicarius* (Linn.).

*Breeding range.*—The summer home of the red phalarope is circumpolar, and the species is known at this season from the whole northern coast and islands of America, Europe, and Asia, except a few regions, the most notable of which is the eastern coast of Greenland. It has been known to breed south to St. Michael, Alaska, 63° N. (Nelson); to Cape Eskimo, west coast of Hudson Bay, 61° N. (Preble); Hudson Strait, 62° N. (Turner); and to the south end of Greenland, 60° N. (Schalow). It has been noted north to 83° N., north of Spitzbergen (Sverdrup); 82° 30' N. on Ellesmere Island (Feilden); Melville Island, 74° 30' N. (Parry); and Point Barrow, 71° N. (Murdoch). It is especially abundant as a breeder along the coast and islands of Arctic America.

*Winter range.*—The Old World winter home of the species extends south to Morocco, India, China, and New Zealand. Knowledge of the winter range in the Western Hemisphere is very meager. The species has been noted in the extreme southern parts of South America on the Falkland Islands (Schalow), and Juan Fernandez (Sharpe); in November, when it may have been migrating, at Coquimbo, northern Chile (Salvin); on December 5 in Chile, locality not designated (Sharpe); specimens are recorded from Argentina and Colombia (Sharpe), without date or locality. The lack of records for this species is remarkable. There seem to be no records whatever for the West Indies nor for the whole of middle America, except the western coast of Lower California, where the species is ordinarily a rare spring and fall migrant, but occasionally is seen in large flocks (Kaeding). Stragglers have been noted at Mount Pleasant, S. C., December 4, 1900 (Wayne); on the coast of northern Lower California, February 21 (Belding); and occasionally in winter at San Diego, Calif. (McGregor).

*Migration range.*—Enormous flocks of the red phalarope have been noted on the Atlantic Ocean during both spring and fall migration. These flocks are common and regular around Newfoundland; become less common southward off the coast of Maine; and are rare off the coast of Massachusetts, except when driven inshore by storms. The red phalarope swims as lightly and easily as any duck, and during migration has been noted repeatedly gathering its food from the surface of the ocean. Indeed, it seems to have an aversion to land except during the breeding season. The migration route by which these flocks of red phalarope pass south after they leave Massachusetts is unknown. The species is known only as a rare straggler on the coast of the United States south of Long Island, and as already remarked is not recorded from the West Indies nor from the east coast of South America north of Argentina. On the Pacific coast the species is an abundant breeder in Alaska, and the flocks pass along the coast of California both spring and fall, after which they can no longer be traced. A few occur on the coast of Lower California, and the species is a rare straggler to the coast of Chile. The principal winter home of the thousands of birds reared each season in arctic America remains yet to be determined.

The red phalarope occurs as a rare straggler in the interior of the United States in migration, and has been recorded from Illinois, Indiana, Ohio, Michigan, Ontario, Wisconsin, Minnesota, Kansas, and Wyoming. The first and only record for Colorado is that of a single specimen taken by Edward A. Preble, of the Biological Survey, July 25, 1895, near Loveland.

*Spring migration.*—Some early flocks appeared off the coast of North Carolina the first week in April, 1896 (Thayer); most of the migration on the coast of Massachusetts occurs during May, especially May 20–30; the first appeared June 2, 1820, on Melville Island, latitude  $74^{\circ}$  N. (Parry), and June 3, 1852 (Armstrong), near the same locality; on June 18, 1883, the first was seen at Fort Conger, Ellesmere Island, latitude  $81^{\circ} 40'$  N. (Greely); and on June 20, 1876, the species appeared 1 degree farther north on the same island (Feilden). Even considering the 1st of May as the time of arrival on the Massachusetts coast, which is probably too early, there are left only fifty days for the 3,000-mile trip from Massachusetts to Ellesmere Island, an average rate of migration of 60 miles per day, which is exceeded by very few species. In spring migration the red phalarope has been noted on the coast of California from April 3 to June 3 (Kaeding), and reached Point Barrow, Alaska, June 4, 1882, and May 30, 1883 (Murdoch).

Eggs have been taken in Greenland June 3–28 (Hagerup); near Fort Anderson June 27 (MacFarlane); and at St. Michael June 8 (Nelson).

*Fall migration.*—The earliest fall birds are seen on the coast of California during July (Loomis); the larger flocks begin to appear late in August and pass south for the next three months. The last seen at Point Barrow, in 1882, was on October 10 (Murdoch). The species was abundant off the coast of Massachusetts August 4, 1877 (Kumlien); and has been noted on Long Island to the third week of November (Braislin).

**Northern Phalarope.** *Lobipes lobatus* (Linn.).

*Breeding range.*—The northern phalarope breeds in the arctic region of both hemispheres, but does not go quite so far north as the last species. It ranges from the Chuckchi Peninsula of Siberia eastward across the whole arctic coast of America to the eastern coast of Greenland. It breeds north to Upernivik, Greenland, 73° N. (Kumlien); Melville Island, 74° N. (Walker); Point Barrow, Alaska, 71° N. (Murdoch); and Wrangel Island, Siberia, 72° N. (Nelson). The main breeding ground lies farther south on the mainland of North America, especially in northern Mackenzie and western Alaska. It breeds south to Ungava Bay, about 59° N. (Turner); near Rupert House, Ontario (Drexler); to near York Factory, Keewatin, 57° N. (Preble); Fort Anderson, Mackenzie, 68° 35' N. (MacFarlane); Pastolik, in the delta of the Yukon, Alaska, 63° N. (Dall and Bannister); and to Kiska Island, near the west end of the Aleutians, 52° N. (Dall). In the Eastern Hemisphere it is an abundant breeder from the limit of tree growth to the Arctic coast, and in eastern Siberia occasionally south to latitude 55°.

*Winter range.*—The winter home of the great flocks of northern phalaropes that breed in arctic America is unknown. The European and Siberian birds winter on the coast of Europe and south to Persia, India, China, and the Malay Archipelago. For the whole of the Atlantic coast of both North and South America there is not a single winter record. A solitary bird was noted at Tumbez, Peru, January 28 (Taczanowski); and the species has been recorded from Chorillos, Peru, without date (Berlepsch and Stolzmann). These are the only certain records for the whole of South America. This lack of winter land records suggests the possibility that both this species and the red phalarope spend the winter in midocean feeding and sleeping on the surface of the water.

*Migration range.*—The northern phalarope comes south along the eastern coast of North America, and is seen commonly as far south as Nova Scotia. The flocks seem normally to strike south from Nova Scotia into midocean, but occasionally they are driven westward by storms and appear on the New England coast, sometimes by thousands. The birds are not rare south to Long Island, but farther south can be considered hardly more than stragglers, though recorded to South Carolina (Loomis).

The northern phalarope is a regular though not common migrant throughout the interior of the United States, and has been recorded from almost every State north of the Ohio River and south to Kansas (Goss) and New Mexico (Henry). There is no record as yet for any of the Gulf States. The species is a common migrant on the Pacific coast of America, and is sometimes abundant south to the coast of central California. Farther south it is less common, though recorded from San Jose, Lower California, in the fall (Brewster), and from the west coast of Mexico in the spring (Nelson). The few noted at Duenas, Guatemala, in August and September (Salvin), and those at Desamparados, Costa Rica (Salvin and Godman), complete the record for Central America.

*Spring migration.*—The northern phalarope was noted in the Bermudas March 21–22, 1848 (Hurdis), and March 8, 1852 (Reid). This is almost two months earlier than the species usually appears on the New England and Long Island coasts. Six years' observations at Montauk Point Light gives May 13 as the mean date of spring arrival—earliest, April 30, 1898 (Scott). Almost all the dates for the coast of Massachusetts are in May. The species arrives at the northern limit of its range about the middle of June. Some late records on the Atlantic coast are: Near Charleston, S. C., June 3, 1903 (Wayne); Montauk Point, New York, June 3, 1894 (Scott); on the coast of Maine to the middle of June (Job).

The northern phalarope was common at Sihuatanejo, on the western coast of Mexico, April 9, 1903 (Nelson); it usually appears on the coast of California in early May, reaches the mouth of the Yukon the middle of May, and was noted in the Kowak Valley, Alaska, May 22, 1899 (Grinnell); Point Barrow, June 11, 1883 (Murdoch), and June 15, 1898 (Stone); Walker Bay, Prince Albert Land, June 15, 1852 (Greely). Individuals are occasionally seen on the California coast in summer, but these are nonbreeders.

Eggs have been taken near Rupert House, Ontario, June 18, 1860 (Drexler); near Fort Anderson, June 16, 1862 (MacFarlane); at Kiska Island, Aleutians, June 30, 1873 (Dall); St. Michael, Alaska, June 1–20 (Nelson); and Kowak Valley, Alaska, June 28, 1898 (Grinnell).

*Fall migration.*—Returning migrants appear on the coast of central California less than six weeks after the northbound flocks disappear, and are common by the end of July. The great flocks pass during August, are less common in September, and cease in October—latest, Monterey, October 24, 1896 (Loomis). The average date of fall arrival at Montauk Point, New York, is August 28—earliest, August 5, 1893, latest, October 22, 1888 (Scott). The last one noted at Point Barrow was seen August 17, 1898 (Stone), and the species usually disappears from the mouth of the Yukon the last of September.

Records of migration in the interior of North America are not numerous. In southwestern Saskatchewan the fall migration opened July 13, 1906, with the arrival of a large flock, and a few days later the birds were abundant. This is only four weeks later than the departure of the northbound migrants, which had been seen in the vicinity in 1905 from May 29 to June 15, and the following year as late as June 14 (Bent). A remarkable flight of northern phalaropes occurred near Terry, Mont., in 1899; during the last ten days of May the birds were exceedingly abundant (Cameron).

**Wilson Phalarope.** *Steganopus tricolor* Vieill.

**Breeding range.**—The northern Mississippi Valley and the adjacent parts of Canada form the principal summer home of the Wilson phalarope. It breeds regularly as far east as northwestern Indiana (Lake County; Butler) and the islands near Green Bay shore (Schoenebeck). Macoun records that a pair nested at Dunnville, Ontario, near the northeastern shore of Lake Erie. Thence the breeding range extends west through central Iowa (Newton; Preston) and northern Colorado (Fort Collins; Cooke) to central California (Lake Tahoe; Bliss; and Las Banos; Mailliard). Instead of penetrating the Arctic regions, as do other phalaropes, this species finds the northern limit of its range in northern Manitoba (Lake Winnipeg; Thompson), central Saskatchewan (Osler; Colt), central Alberta (Edmonton; Macoun), northern Washington (Cheney; Johnson), and probably southern British Columbia.

**Winter range.**—The few winter records for this species come from South America—from central Chile (Philippi) and central Argentina (Durnford) south to Patagonia (Durnford) and the Falkland Island (Sclater). There is a single record in fall migration for western Brazil (Pelzeln). and one in May for central Peru (Berlepsch and Stolzmann). Three specimens were collected January 19, 1890, at Corpus Christi, Tex. (Sennett), but these were apparently laggards, for the species is not usually seen in Texas after September.

**Migration range.**—During the fall migration individuals wander eastward to the Atlantic coast and have been noted from New Jersey to Montreal. There is also one May record for Massachusetts (Baird, Brewer, and Ridgway) and one June record for Maine (Smith). The species seems to be unknown on the Atlantic coast between New Jersey and Argentina. The principal summer home is in western North America, and most of the species migrate south through Mexico and along both Mexican coasts, and then apparently cross directly to the west central coast of South America, since the species is unknown in Central America east of Guatemala and in South America north of Peru.

**Spring migration.**—The Wilson phalarope arrives in central Kansas on the average April 27, earliest April 23, 1885 (Kellogg); northern

Colorado about May 1; Chicago, Ill., average May 6; Heron Lake, Minn., average May 11, earliest May 8, 1889 (Miller); Hallock, Minn., average May 14, earliest May 9, 1896 (Peabody); Reaburn, Manitoba, average May 21, earliest May 16, 1898 (Wemyss); Osler, Saskatchewan, May 19, 1893 (Colt).

The earliest eggs in northern Iowa are deposited about May 20 (Anderson); eggs nearly hatched have been found in southern Saskatchewan June 7 (Macoun); young just hatching, June 16, at Lake Tahoe, California (Bliss), and at the same stage June 22, at Fort Klamath, Oregon (Merrill).

*Fall migration.*—The Wilson phalarope moves southward so early that most have left the breeding grounds soon after the middle of August; the last seen at Lanesboro, Minn., in 1885, was on September 13 (Hvoslef). The species continues passing through Mexico until October (Ferrari-Perez).

*Avocet. Recurvirostra americana* Gmel.

*Breeding range.*—The central western United States is the principal summer home of the avocet, but its breeding range extends north to central Wisconsin (Green Bay; Kumlien), southern Manitoba (Souris; Thompson), southern Saskatchewan (Osler; Colt), southern Mackenzie (Fort Rae; Ross), and central Oregon (Haines; Haines). It breeds south to northern Iowa (Hawarden; Anderson), northwestern Texas (Oberholser), southeastern New Mexico (Carlsbad; Bailey), and to Orange County, Calif. (Santa Ana; Grinnell). Many years ago this species was not rare on the Atlantic coast, and a few are known to have nested at Egg Harbor, N. J. (Giraud). At the present time it is a very rare visitor to any part of the Atlantic coast, and has scarcely been seen in New Jersey for the last twenty years. At various times in the past the avocet has been recorded along the coast from Florida (Cory) to southern New Brunswick (Chamberlain); one of the latest records is that of three birds seen September 13, 1896, at Ipswich Neck, Mass. (Kennard), and a single bird taken October 8, 1903, at St. Marys, Ga. (Arnow). The species occurs in the interior east of the Mississippi River, as a rare visitor from Louisiana (Audubon) to Ontario (Fleming), but is known to breed only in Wisconsin.

*Winter range.*—The avocet winters abundantly on the coast of Texas (Merrill) and in southern California (Newberry); sparingly through Chihuahua and Lower California and thence south to Guatemala (Salvin). During migration it has wandered a few times to Cuba (Gundlach), Jamaica (Gosse), and twice even to Barbados (Feilden).

*Spring migration.*—The month of April is the time of most activity in spring migration. By the latter part of this month the birds have reached South Dakota, and their average date of arrival at Great

Falls, Mont., is April 24 (Williams). They have even been noted at Salt Lake, Utah, as early as March (Baird), and at Ash Meadows, Nev., March 15, 1891 (Fisher). They appeared April 28, 1908, at Okanagan Landing, B. C. (Brooks), May 14, 1892, at Indian Head, Saskatchewan (Macoun), and June 1, 1864, at Fort Resolution, Mackenzie (Preble).

Eggs have been taken at Santa Ana, Calif., as early as May 3 and as late as July 6 (Grinnell); eggs nearly ready to hatch were found at Hawarden, Iowa, June 2, 1900 (Anderson), and at Crane Lake, Saskatchewan, June 9, 1894 (Macoun).

*Fall migration.*—The southward movement begins so early that by the last of August the first migrants have reached southern Mexico. Individuals have been seen in Nebraska as late as October 27, 1899 (Wolcott), and at Salt Lake, Utah, until a month later. Other late dates are: Cape Elizabeth, Me., November 5, 1878 (Brown); St. Mary Reservoir, Ohio, November 10, 1882 (Dawson); Oberlin, Ohio, November 4, 1907 (Jones); near New Orleans, La., November 12, 1889 (Beyer), and Johnsons Bayou, La., November 26, 1882 (specimen in United States National Museum).

**Black-necked Stilt.** *Himantopus mexicanus* (Müll.).

*Breeding range.*—The black-necked stilt is one of the very few shorebirds that breed in the United States and also in the Tropics. The breeding range extends north to Florida (Scott), Louisiana (Beyer), Texas (Merrill), southern Colorado (Henshaw), northern Utah (Allen), and central Oregon (Burns; Preble). More than half a century ago the species nested on Egg Island in Delaware Bay (Turnbull) and as late as 1881 still bred on the coast of South Carolina (Wayne). At the present time the bird is unknown along the whole Atlantic coast north of Florida, though formerly it has been noted locally to northern New England, and in September, 1880, one was seen at Mace Bay, New Brunswick (Chamberlain). In the interior of the United States the species is recorded as a straggler north to Ohio (Langdon), Michigan (Gibbs), Wisconsin (Hoy), Iowa (Rich), and Nebraska (Bruner, Wolcott, and Swenk), but is not known to breed east of the Rocky Mountains north of Texas. The southern limit of the breeding range is not yet well known. The species is a tolerably common resident of the entire West Indies and the whole northern coast of South America. It probably breeds south to central Peru and to the Lower Amazon. It breeds on the islands off the coast of Yucatan (Salvin), and probably on the coast of northeastern Mexico, and south to southern New Mexico (Carlsbad; Bailey) and southern California (Santa Ana; Grinnell). The early explorers of the West recorded it north to the Columbia River, but there are no definite breeding records so far north.

*Winter range.*—A few winter in southern Florida (Myers; Scott) and on the coasts of Louisiana (Beyer) and Texas (Corpus Christi;

Rhoads), and from southern Sinaloa (Mazatlan; Nelson) and southern Lower California (La Paz; Ridgway), south throughout Central America and the West Indies to central Peru (Santa Lucia; Taczanowski) and the mouth of the Amazon (Sclater and Salvin). The species winters on the Galapagos Islands, and possibly a few remain to breed (Rothschild and Hartert).

*Spring migration.*—The slight northward migratory movements of this species occur principally in April. Some dates of arrival are: Titusville, Fla., March 11, 1905 (Worthington); Sioux City, Iowa, April 20, 1902 (Rich); Omaha, Nebr., April 20, 1895 (Bruner, Wolcott, and Swenk); Escondido, Calif., April 13, 1896, April 15, 1897 (Hatch); Fresno County, Calif., April 5, 1890 (Eaton); Stockton, Calif., April 13, 1878 (Belding).

Eggs have been taken in southern California from early May to August, and at Salt Lake, Utah, May 22 (Ridgway). At Fort Garland, Colo., the young were just hatched June 21, 1873 (Henshaw).

*Fall migration.*—The latest dates in Nebraska are in early October, and the species has been noted at Riverdale, Calif., as late as November 19, 1891 (Eaton).

**European Woodcock.** *Scolopax rusticola* Linn.

The European woodcock is widely distributed in Europe and western Asia. It breeds in northern Europe and northern Asia from beyond the Arctic Circle south to England, Silesia, the Alps, the Himalayas, and the mountains of Japan; also on the Azores, Madeira and Canary islands. It winters from the British Islands, southern Europe and China, to northern Africa, India, and Formosa; it wanders occasionally to eastern North America, and has occurred in Loudoun County, Va., in 1873 (Coues); Chester County, Pa., the end of November, 1886 (Stone); one was taken near Shrewsbury, N. J., December 6, 1859 (Lawrence); one, September, 1889, somewhere in New Jersey (Warren); one, probably of this species, near Newport, R. I. (Baird, Brewer, and Ridgway); one at Chambly, Quebec, November 11, 1882 (Wintle); and one at St. John, Newfoundland, January 9, 1862 (Sclater).

**Woodcock.** *Philohela minor* (Gmel.).

*Breeding range.*—The woodcock breeds locally throughout most of its range in the United States, at least south to Jacksonville, Fla. (Brewster), the coast of Louisiana (Beyer), and to Neosho Falls, in southern Kansas (Goss). It will probably be found breeding in some of the bottomlands of eastern Oklahoma. The breeding range extends northward to Pictou, Nova Scotia (McKinlay); Prince Edward Island (Dwight); Chatham, New Brunswick (Baxter); the city of Quebec (Dionne); Bracebridge, Ontario (Macoun); the northern peninsula of Michigan, at Keweenaw Point (Kneeland); extreme northeastern Minnesota, at Elbow Lake (Roberts and Benner); and to Winnipeg,

Manitoba (Thompson). The species has wandered north to Newfoundland (Bennett); was noted the end of August, 1879, at York Factory, Keewatin (Bell); and early in August, 1892, on Black River, Saskatchewan (Tyrrell), at latitude 59°—the most northern and also the most western record known. The woodcock has been seen several times in Colorado near Denver (Smith), though its regular range extends only to eastern South Dakota and eastern Kansas.

*Winter range.*—The woodcock remains in the north until driven away by frost, and the presence of unfrozen ground is the factor that determines the northern boundaries of its range through the winter. The larger part of the species winter in the Gulf States south at least to southern Florida (Myers; Scott) and to southern Texas (Victoria; Mitchell), but in Texas the species is very rare. Few woodcock winter north of latitude 37°, but these few are scattered at favorable localities over a wide area north to Long Island (Giraud), Grafton, Mass. (Mackay), and Vincennes, Ind. (Balmer). Woodcock have been taken several times in December at St. John, New Brunswick, but in each case they proved to be wounded birds (Gilbert). The species has been taken once in the Bermudas, in October, 1842 (Hurdis).

*Spring migration.*—Not only does the woodcock remain as far north as possible through the winter, but it also pushes northward in spring as soon as frost releases its feeding grounds. Average dates of spring arrival are: Renovo, Pa., March 22, earliest March 13, 1897 (Pierce); Long Island, New York, March 15, earliest March 10, 1898; central Connecticut, average of twelve years March 20, earliest February 24, 1891; eastern Massachusetts, average of eight years March 16, earliest February 22, 1902; southwestern Maine, March 29, earliest March 23, 1905; Halifax, Nova Scotia, March 25, earliest March 10, 1890 (Piers); St. John, New Brunswick, April 3, earliest March 21, 1898 (Banks); Pictou, Nova Scotia, April 12, earliest April 6, 1892 (McKinlay); city of Quebec, average of thirteen years April 17, earliest April 4, 1890 (Dionne); Hillsboro, Iowa, March 17, earliest March 15, 1898 (Savage); Waterloo, Ind., March 11, earliest March 1, 1906 (Link); Oberlin, Ohio, March 21, earliest March 10, 1902 (Jones); Petersburg, Mich., March 17, earliest March 2, 1887 (Trombley); Chicago, Ill., March 26, earliest March 22, 1884 (Wentworth); southern Ontario, April 2, earliest March 26, 1901; Ottawa, Ontario, May 1, earliest April 20, 1890 (White); Quebec, Canada, earliest April 20, 1907 (Dionne).

One of the most pronounced peculiarities of the woodcock is the early date at which it breeds, especially in the Gulf States. Young a few days old were found January 29, 1890, at Covington, La. (Beyer), which requires that the eggs should have been deposited in December. Young a week old were noted at Jacksonville, Fla., March 10, 1877 (Brewster); young at Sourlake, Tex., March 22, 1905 (Gaut); young

a week old at Falls Church, Va., April 18, 1897 (Riley); young just hatched, Norwich, Conn., April 5, 1888 (Rawson); young just hatched, Spearville, Ind., April 13, 1894 (Barnett); young, Oberlin, Ohio, April 19, 1901 (Baird); while eggs have been taken at Caper Island, South Carolina, February 13, 1903 (Wayne); Raleigh, N. C., March 9, 1892 (Brimley); Lower Cedar Point, Maryland, February 25, 1891 (Todd); Fallstown, Md., March 30, 1880 (Kirkwood); Lawrenceville, N. J., March 14, 1889 (Phillips); Rockland, Me., April 26, 1886 (Norris); Wheatland, Ind., March 14, 1882 (Ridgway); and at Vermilion, S. Dak., April 21, 1884 (Agersborg).

The average date of the last woodcock seen at Ottawa, Ontario, is October 19, latest October 23, 1885 (White); average southern Ontario October 21, latest November 6, 1889; usually leave Montreal, Canada, about October 20, but were seen in 1880 to December 16 (Wintle); St. John, New Brunswick, average date of the last seen November 10, latest November 13, 1888 (Banks); Halifax, Nova Scotia, average November 6, latest December 4, 1895 (Piers); south-western Maine, average of nine years October 22, latest November 23, 1900.

**European Snipe.** *Gallinago gallinago* (Linn.).

The European snipe is an Old World species breeding in Iceland and throughout northern Europe and Siberia and south to the Alps, southern Russia, and Turkestan. It winters south to northern Africa and to China, Formosa, and the Philippines. It has been taken twice in the Bermudas—December 24 and 29, 1847 (Reid), and three times in Greenland—at Nanortalik, September 6, 1840; at Fiskenaes, October, 1845, both on the west coast of Greenland (Winge); and the third instance was May 29, 1902, at Angmagsalik, on the eastern coast (Helms). A specimen in the British Museum is marked as having come from Canada, but nothing is known of its history.

**Wilson Snipe.** *Gallinago delicata* (Ord).

**Breeding range.**—The northern limit of the breeding range of the Wilson snipe extends from Newfoundland (Reeks) and northern Ungava (near Fort Chimo; Turner) to northern Mackenzie (Dease River; Hanbury) and (Fort Anderson; MacFarlane), northern Yukon (La Pierre House; Catalogue United States National Museum), and northwestern Alaska (Kowak River; Grinnell), apparently following closely the limit of trees. Snipe have been noted a few times on the west coast of Greenland (Winge), but there is nothing to prove that they breed in that country. The species breeds south to New Jersey (Trenton; Abbott), northern Indiana (Davis Station; Deane), northern Illinois (Waukegon; Nelson), northern Iowa (Union Slough, Kossuth County; Anderson), southern Colorado (San Juan County; Drew), northern Nevada (Ridgway), and northern California (Eagle Lake; catalogue egg collection, United States National Museum).

*Winter range.*—During the winter season some Wilson snipe leave the United States and pass even to northern South America, on the east side to Rio Janeiro (Pelzeln) and on the west to Medellin, Colombia (Sclater and Salvin). A few winter in the Lesser Antilles and many in Jamaica, Cuba, and the Bahamas. The species is common in Mexico and Guatemala, less common in the remainder of Central America. A large part of the species winters in the southern United States, where it was formerly enormously abundant. No exact limit can be given to the northern range in winter. The Wilson snipe can not live where the ground is frozen. Hence the normal northern winter limit would extend from North Carolina through Arkansas to New Mexico and on the Pacific slope to northern California. But many snipe pass the winter much north of the zone of frozen ground, feeding about streams or springs. A few can be found almost every winter on Cape Cod, Massachusetts (Mackay), and a pair were seen during January and February, 1896, as far north even as Wolfville, Nova Scotia (Tufts). From the Mississippi Valley snipe are reported as wintering north to northern Illinois and northern Nebraska (Bruner, Wolcott, and Swenk), while in the Rocky Mountains of Colorado at 8,000 feet near Sweetwater Lake, the presence of warm springs has enabled them to remain the entire winter, though the air temperature fell to  $-30^{\circ}$  F. (Gilmore). They have been known also to winter in northern Montana (Coubeaux) and northern Washington (Snyder). A few snipe appear almost every fall in the Bermuda Islands (Jardine) and sometimes remain through the winter, though usually they are rare in spring.

*Spring migration.*—A series of nearly twenty years of observations near Alexandria, Va., gives the average date of arrival as March 8, with the earliest February 17, 1897 (Greenwood); the species is most common the last week in March. The average date of arrival in central New Jersey is March 22, earliest March 4, 1877. Some other dates of arrival are: Central Connecticut, average March 23, earliest March 18, 1894; eastern Massachusetts, average April 2, earliest March 21, 1887; southwestern Maine, average April 27, earliest April 14, 1897; Scotch Lake, New Brunswick, earliest April 5, 1907 (Moore); Pictou, Nova Scotia, average April 19, earliest April 11, 1889 (Mackinlay); city of Quebec, average April 23, earliest April 18, 1899 (Dionne).

The movements in the Mississippi Valley are at closely corresponding dates: Central Missouri, average date of arrival March 13, earliest February 17, 1897; Oberlin, Ohio, average March 28, earliest March 19, 1897 (Jones); Chicago, Ill., average April 3, earliest March 17, 1894 (Blackwelder); southern Michigan, average April 3, earliest March 21, 1893; southern Ontario, average April 15, earliest April 1, 1900; Ottawa, Ontario, average April 26, earliest April 12, 1902

(White); Keokuk, Iowa, average March 23, earliest March 13, 1900 (Currier); central Iowa, average March 22, earliest March 11, 1897; southern Wisconsin, average March 30, earliest March 18, 1894; Heron Lake, Minn., average April 5, earliest April 1, 1888 (Miller); central South Dakota, average April 11, earliest April 7, 1890; Aweme, Manitoba, average April 24, earliest April 18, 1896 (Criddle); central Montana, average April 4, earliest March 27, 1894; Rathdrum, Idaho, average April 14, earliest April 8, 1899 (Danby); Okanagan Landing, British Columbia, April 8, 1907 (Brooks); Bulyea, Alberta, April 27, 1904 (Huck); near Fort Providence, Mackenzie, May 2, 1904, and May 1, 1905 (Jones); Fort Simpson, Mackenzie, May 10, 1904 (Preble); Nushagak, Alaska, April 25, 1882 (McKay); Fort Reliance, Yukon, May 2 (Sharpe); Fort Kenai, Alaska, May 5, 1869 (Bischoff); Nulato, Alaska, May 21, 1868 (Dall); Kowak River, Alaska, May 22, 1899 (Grinnell).

In southern Louisiana the average date of departure is April 19, latest April 30, 1887; Raleigh, N. C., average April 26, latest April 28, 1898 (Brimley); central Nebraska, average April 27, latest May 18, 1899; Chicago, Ill., average May 4, latest May 6, 1904 (Dearborn); Oberlin, Ohio, average May 5, latest May 16, 1904 (Jones). Some late dates of the last seen are: San Jose, Costa Rica, February 16, 1890 (Cherrie); Gainesville, Fla., April 15, 1887 (Chapman); Lake Ellis, N. C., May 9, 1906 (Brimley); Washington, D. C., May 4, 1900 (Preble); Bay St. Louis, Miss., May 10, 1902 (Allison); Dallas, Tex., May 1, 1898 (Mayer); Long Pine, Nebr., May 18, 1899 (Bates).

Eggs have been taken at Meadville, Pa., May 13, 1875 (Huidekoper); young about two days old at Trenton, N. J., May 26, 1876 (Abbott); eggs at Branchport, N. Y., May 20, 1896 (Stone); near Waukegan, Ill., April 24, 1896 (Deane); Davis Station, Ind., April 24, 1898 (Deane); Pewaukee, Wis., May 12, 1871 (Goss); Elk River, Minn., May 24, 1884 (Bailey); Minneapolis, Minn., May 14, 1887 (Cantwell); American Fork, Utah, April 29 (Johnson); Fort Klamath, Oreg., May 20, 1883 (Bendire); Yukon River, Alaska, May 28, 1861; Fort Resolution, Mackenzie, May 30, 1864 (Lockhart); Shumagin Islands, Alaska, June, 1895 (Call).

Few of the shorebirds suffer so much from spring shooting as the Wilson snipe. All winter long in the swamps of the southern States it is persecuted by hunters, and as it moves northward it meets a fusillade throughout its whole course. In the central parts of the South shooting is at its height early in March, and just south of the breeding range the bulk of the birds pass early in April.

*Fall migration.*—July birds south of the breeding grounds are very rare, though they have been noted at Bay St. Louis, Miss., on the very early date of July 29, 1901 (Allison). Some dates of arrival

in the fall are: Washington, D. C., August 30, 1894 (Richmond); Frogmore, S. C., September 16, 1885 (Hoxie); northern Florida, average September 26, earliest September 20, 1904 (Williams); southern Louisiana, average August 29, earliest August 25, 1901 (Ballowe); Lincoln, Nebr., August 7, 1900 (Wolcott); San Bernardino River, Sonora, August 19, 1893 (Mearns); San Jose del Cabo, Lower California, August 28, 1887 (Brewster); San Jose, Costa Rica, October 9, 1889 (Cherrie); Bermudas, September 13 (Reid); Barbados, West Indies, October 11, 1886 (Manning). The hunter near Newport, R. I., secured scarcely a third as many snipe in the fall as in the spring—466 birds in the eight years; earliest July 30, 1870, latest November 14, 1871. The average dates were August 19 to October 27 (Sturtevant).

Some dates of the last seen are: Near Jasper House, Alberta, September 13, 1896 (Loring); Aweme, Manitoba, average October 11, latest November 7, 1907 (Criddle); Lanesboro, Minn., October 31, 1887 (Hvoslef); Keokuk, Iowa, average November 23, latest November 28, 1889 (Currier); Oberlin, Ohio, latest November 22, 1890 (Jones); Ottawa, Ontario, average November 2, latest November 18, 1900 (White); Chicago, Ill., average October 31, latest November 13, 1885 (Holmes); St. John, New Brunswick, November 5, 1889 (Banks); Halifax, Nova Scotia, average November 23, latest December 3, 1894 (Piers); southwestern Maine, average October 21, latest November 8, 1873; Montreal, Canada, average October 30, latest November 13, 1897 (Wintle).

**Great Snipe.** *Gallinago media* (Latham).

The great snipe is a species of wide distribution in the Eastern Hemisphere. Its breeding range extends from the Scandinavian Peninsula to the Yenisei River of Siberia and from Prussia north to at least 71° north latitude. The winter home is from the Mediterranean to South Africa, and during its migration the species occurs from Great Britain to Persia.

The only record for the Western Hemisphere is that of a skin presented by the Hudson's Bay Company to the British Museum (Sharpe). There is no reason for doubting that the specimen was taken in Canada, but no definite locality can be assigned.

**Dowitcher.** *Macrorhamphus griseus* (Gmel.).

**Breeding range.**—The nest and eggs of the dowitcher are not yet known to science, nor has the species been seen in summer at any place where it was probably breeding. The dowitcher is a common migrant on the coasts of New Jersey, New York, Rhode Island, and Massachusetts, and in fall is sometimes very abundant. Farther north its numbers decrease: New Hampshire, tolerably common in fall, no spring records; Maine, tolerably common spring and fall; Quebec, rare migrant; New Brunswick, no records; Nova Scotia,

once (Sharpe); Prince Edward Island, once; Ungava, a few in August, 1860, at Henley Harbor (Coues), one June 10, 1863, at Fort Chimo (Turner). North of Ungava, the only record is that of a single accidental occurrence at Fiskenaes, Greenland (Reinhardt). Evidently the dowitcher does not breed in any numbers on the eastern coast of Ungava. The probability that it does not breed there at all is strengthened by the fact that several first class observers, who during the fall migration were in the Gulf of St. Lawrence, did not see any of the birds. It undoubtedly does not go into north-eastern Keewatin and the islands of the Province of Franklin, for it is not reported by the various expeditions that have traveled and wintered in those districts, while the specimens taken on the west coast of Hudson Bay belong to the form called *scolopaceus*. The only district left for the breeding ground is the interior of Ungava and the eastern shore of Hudson Bay.

*Winter range.*—The dowitcher ranges south in winter through the West Indies to the northern coast of South America and to the Amazon River (Sharpe). It remains at least as far north as northern Florida (Worthington) and probably a few as far west on the Gulf coast as Louisiana.

*Spring migration.*—The first one seen in 1890 at Darien, Ga., was on March 20 (Worthington); the average date of arrival on the southern coast of South Carolina is March 23, earliest March 17, 1885 (Hoxie); central North Carolina, average April 30; Pea and Bodie Islands, North Carolina, April 27, 1905 (Bishop); Long Beach, New Jersey, May 13, 1877 (Scott).

The species is rare west of the Allegheny Mountains, but a few specimens have been reported: Near Chicago, Ill., May 6, 1893 (Woodruff); Toronto, Ontario, not common May 16–31. This last locality seems to be about as far west as the dowitcher occurs regularly, though formerly it probably ranged west to Lake Michigan.

The species is not uncommon on the coast of Florida throughout the summer, but the individuals remaining so far south do not assume the breeding plumage (Scott). Migrants are common in Florida until the last week in May, and on the coast farther north the last leave for the breeding grounds about the first of June (Scott).

*Fall migration.*—The first migrants appear on the New England coast early in July: Edgartown, Mass., July 4, 1891 (Worth); near Newport, R. I., July 7, 1871 (Sturtevant); Long Beach, New Jersey, July 6, 1877 (Scott); Bone Island, Virginia, July 14, 1880 (Ridgway); Erie, Pa., July 19, 1892 (Todd); Pea and Bodie islands, North Carolina, July 7, 1904 (Bishop); Barbados, West Indies, August 24, 1888 (Feilden). A market hunter near Newport, R. I., shot 1,058 dowitchers during 1867–1874—extreme dates July 7, 1871, and October 20, 1870, and average date of arrival July 17 (Sturtevant). Some dates

of the last seen are: Henley Harbor, Ungava, August 21, 1860 (Coues); Montreal, Canada, September 27, 1892 (Wintle); Toronto, Ontario, September 15, 1889 (Fleming).

**Long-billed Dowitcher.** *Macrorhamphus griseus scolopaceus* (Say).

**Breeding range.**—The long-billed dowitcher was found as a fairly common breeder in the Anderson River region, Mackenzie (MacFarlane), and breeds thence west along the Arctic coast to Point Barrow, Alaska (Murdoch), though not commonly. It is an abundant breeder at the mouth of the Yukon and on the shores of Norton Sound (Nelson). The species is known from the northern coast of eastern Siberia (Palmen), but as yet has not been found there breeding.

**Winter range.**—The principal winter home seems to be the shores of the Gulf of Mexico; the species is common as far east as the Gulf coast of Florida (Scott), and a few pass on to Cuba (Lawrence). It is common in Mexico and Guatemala, has been recorded as far south as Costa Rica (Frantzius), and it is probably this form that occurs in Panama (Lawrence).

Some form of the dowitcher occurs on the coast of Ecuador (Salvadori and Festa) and in Peru as far south as Tumbes (Taczanowski), but whether the eastern or western form has not yet been ascertained.

**Migration range.**—There is a decided easterly fall migration which brings quite a number of long-billed dowitchers to the Atlantic coast of the United States. They are fairly common from Long Island southward, and a few have been taken on the coasts of Rhode Island (Howe and Sturtevant) and Massachusetts (Brewer); and one, August 12, 1891, at Hamilton, Ontario (Fleming). This is the form common in the Mississippi Valley and it is also more common than *griseus*, at least as far east as Ohio. There is one record of its accidental occurrence in Japan (specimen in United States National Museum).

**Spring migration.**—The long-billed dowitcher is only a straggler in spring on the Atlantic coast, but has been recorded at Washington, D. C., in April, 1884 (Smith and Palmer); Cape May, N. J., May, 1848 (specimen in United States National Museum); while on Long Island, New York, a very early individual was seen March 20 (Lawrence). The species normally reaches northern Indiana and northern Illinois late in April, but one was taken in 1889 at English Lake, Indiana, on the early date of March 11 (Butler). It was enormously abundant along the west shores of Lake Michigan in the early days of the settlement of the country, but of late years has become quite rare. Some dates of arrival farther west are: Fort Brown, Tex., March 27, 1853 (Cassin); Corpus Christi, Tex., March 24, 1889 (Sennett); Lawrence, Kans., April 19, 1873 (Snow); Omaha, Nebr., April 28, 1856 (Cassin); Cheyenne, Wyo., May 3, 1889 (Bond); Fort Kenai, Alaska, May 4, 1869 (Osgood); St. Michael, Alaska, May 18, 1877 (specimen in Sennett collection); Fort Anderson,

Mackenzie, May 28, 1865 (MacFarlane); Point Barrow, Alaska, June 19, 1882 (Murdoch).

Eggs were taken at St. Michael, Alaska, May 23, 1880 (Nelson); near Fort Anderson, Mackenzie, June 21, 1864, and June 15, 1865 (MacFarlane); incubating birds were taken at Point Barrow, Alaska, June 28, 1883 (Murdoch).

*Fall migration.*—Southward-bound migrants were abundant July 31, 1900, on the west shore of Hudson Bay near Fort Churchill (Preble), and this must have been nearly the last of the migration, for none were seen after three days later. By this date the earliest migrants were already far south, as shown by the following dates of arrival: Fort Kenai, Alaska, July 20, 1869 (Osgood); Tulare Lake, Calif., July 8, 1907 (Goldman); Hay Creek, Saskatchewan, July 3, 1906 (Bent); Denver, Colo., July 24, 1873 (Henshaw); Long Island, New York, July 23, 1884 (Dutcher); Pea and Bodie islands, North Carolina, July 7, 1904 (Bishop); San Mateo, Oaxaca, August 12, 1869 (specimen in United States National Museum).

The last were seen at Point Barrow, Alaska, August 17, 1882 (Murdoch), and August 26, 1897 (Stone); Chilliwack, British Columbia, October 29, 1888 (Brooks); Hutton Lake, Wyoming, October 14, 1899 (Knight); Mimbres, Ariz., October 22, 1873 (Henshaw); Souris River, North Dakota, October 1, 1873 (Coues); Lincoln, Nebr., October 20, 1900 (Wolcott); Long Island, New York, October 15, 1884 (Lawrence).

*Stilt Sandpiper.* *Micropalama himantopus* (Bonap.).

*Breeding range.*—Information concerning the nesting of the stilt sandpiper is very meager. Several sets of eggs and some young birds were taken at Franklin Bay on the Arctic coast of Mackenzie and one nest was found at Rendezvous Lake, a few miles back from the coast (MacFarlane). A Biological Survey party found young of the year (probably migrants) July 19, 1900, near York Factory, Keewatin, and noted old birds August 12 near Cape Eskimo (Preble). The young were probably hatched somewhere on the Barren Grounds north of York Factory. The record from these regions seems to be the only data so far obtained bearing on the summer home of the species. It is probably safe to say that the breeding range extends along the Arctic coast and the adjoining tundras from near the mouth of the Mackenzie to the tree limit on the western shores of Hudson Bay.

*Winter range.*—If the winter home is to be determined solely by specimens noted or taken in winter, then it must be said that the winter home of the stilt sandpiper is unknown; for there seem to be only two records of the species anywhere for the months of November, December, and January. One of these is in Mexico (Ferrari-Perez) and the other in Texas (Sennett), and probably both were accidental

occurrences. This is one of the rarer sandpipers and the total number of individuals is not great. The species is apparently most common on the Atlantic coast, while a smaller number occur around the Great Lakes and along the eastern edge of the Great Plains in the line leading to the coast of southern Texas. The winter home is therefore to be sought in a southerly direction from the eastern United States. The total records for the whole of Central America are only three, one each in Guatemala (Sclater and Salvin), Nicaragua (Sharpe), and Costa Rica (Zeledon); while the species is recorded as a tolerably common migrant in each of the Greater Antilles and in six islands of the Lesser, but as more common in the Lesser than the Greater Antilles. This latter fact indicates that the principal winter home lies along the Atlantic coast of South America, although records to substantiate this supposition are lacking. The South American records are as follows: Cienega, Colombia, September 13 (Allen); Barbahoyo (Sclater) and Vines (Salvadori and Festa), Ecuador, each in September; Yquitos, Peru, September and August (Sharpe); Chorillos, Peru (Taczanowski); Nauta, Peru, September, October, March, and April (Sclater and Salvin); Falls of the Madeira, Bolivia, October (Allen); Ilha Grande, Brazil, August (Sharpe), and Matto Grosso, Brazil, October (Pelzeln). There remain the records of specimens taken in Chile (Sharpe) and at Colonia, Uruguay (Sharpe), without date of capture. Present knowledge is therefore summed up by the statement: It winters in South America, south to Chile and Uruguay. One specimen is recorded as taken at Laguna del Rosario, Mexico, in January (Ferrari-Perez), and one at Corpus Christi, Tex., January 19, 1890 (Sennett). As already stated, it is not probable that the stilt sandpiper winters regularly at either of these localities. One taken February 8, 1892, at Manzanillo, Mexico, by Nelson and Goldman of the Biological Survey, may have been an early spring migrant.

*Spring migration.*—The species is rare in spring migration along the Atlantic coast—indeed, the records are so few that it might be called occasional or even accidental. Some of these records are: Jamaica, April (March); Cuba, April (Gundlach); Sullivan Island, South Carolina, May 11, 1885 (Sennett); Cape Hatteras, North Carolina, May 19, 1898 (Pearson); Long Island, New York, once in May (Chapman), one June 16, 1863 (specimen in United States National Museum); Rhode Island, May 9, 1895 (Howe and Sturtevant). The principal route of spring migration seems to be up the Mississippi Valley and particularly along the direct course from the coast of Texas to Great Slave Lake. Most of the dates of arrival are in May. Some of the more northern are: Indian Head, Saskatchewan, May 18, 1892 (Macoun); Fort Resolution, Mackenzie, May 19, 1860 (Kennicott); Cheyenne, Wyo., May 25, 1889 (Bond); Fort Chipewyan Alberta,

June 6, 1893 (Russell); the last one noted at Indian Head in 1892 was June 5 (Macoun). Eggs were taken on Anderson River, Mackenzie, June 24, 1863; at Rendezvous Lake, June 27, 1865; and young at Franklin Bay, July 8, 1865 (MacFarlane).

*Fall migration.*—That fall migration begins as early as possible is evidenced by the presence of the species in Peru and Brazil by August. It is said to arrive on Grenada and Barbados, West Indies, in July, and the earliest records on the Atlantic coast of each of the New England States is in the same month—earliest July 6, 1874, near Newport, R. I. (Sturtevant). As late as 1879 Doctor Brewer stated that it was not yet known to be a regular migrant in this region, while a gunner near Newport, R. I., had listed 279 individuals, shot in 1867–1874, the dates ranging from July 6 to September 19 (Sturtevant), but these records were not published until 1901. Along this part of its course the species is most common in August, and most have departed by early September. Some late dates are: Newfoundland, one September, 1867 (Reeks); St. John, New Brunswick, September 8, 1881 (Chamberlain); Portland, Me., October 13, 1906 (Eastman); Key West, Fla., November 1, 1888 (Scott); Barbados (Feilden), Grenada (Wells), and in Trinidad (Leotaud), a few remain until October. The species has been noted as casual or accidental in Colorado (Thorne), Montana (Coues), British Columbia (Brooks), and Bermuda (Hurdis).

*Knot. Tringa canutus* Linn.

*Breeding range.*—The summer range of the knot is almost circum-polar, extending from Iceland across the whole of Arctic America and westward to northwestern Siberia. The species has also been taken once in Spitzbergen, but seems in general to be lacking in the Arctic regions north of Europe. There is every reason for believing that the species breeds locally throughout its summer range, but authentic eggs are a great desideratum. Eggs claimed to be positively identified have been collected at four localities: Fort Conger, Grinnell Land, June 9, 1883 (Greely); Disko, Greenland, 1875 (Seeböhm); Iceland, June 17, 1898 (Ottosson); Taimyr Peninsula, Siberia, July 6, 1901 (Dresser). These eggs differ so much in size, shape, and coloration that some of them must have been wrongly identified. One of the latest expeditions into the Arctic regions saw young at Goose Fiord, latitude 76° 30' N., but found no eggs (Sverdrup). The species was found breeding commonly at Igloodik on Melville Peninsula, latitude 69°, in the summer of 1823 (Parry), but none of the many eggs collected were preserved. Three years earlier it had been noted as an abundant breeder on Melville Island (Sabine). At that time the bird was undoubtedly many times more common than now. The Iceland record at 66° latitude is the most southern breeding record, and nestlings have been taken on Grinnell Land at 82° 44' latitude. These represent the extremes of the breeding range.

*Winter range.*—The breeding knots of Siberia go south in winter to southern Africa, India, Australia, and New Zealand; those from Arctic America winter in South America, south to Tierra del Fuego, where they were found to be common February, 1895 (Schalow). The species is recorded locally from the coasts of South America, but present data are not sufficient to define the northern limits of the winter range. It is not probable that the knot winters regularly anywhere north of South America, and all records to the contrary, as the three seen in January, 1890, on Muskeget, Mass. (Mackay), must be considered as accidental. On Barbados the species has been noted as late as December 27, 1886 (Manning), but it is there considered to be only a migrant.

*Migration range.*—The principal migration route is along the Atlantic coast, where the knot is known locally from Florida to Newfoundland, and was formerly quite common. There are notable gaps in the records of this species. It is known locally as a tolerably common migrant throughout the Mississippi Valley east of the ninety-eighth meridian, but apparently these Mississippi Valley birds pass north and a little east to Hudson Bay and thence to the Arctic islands, for the species is unrecorded in the whole interior of Canada west of Hudson Bay, and has not been found even on the Arctic coast of Mackenzie. Southward there is another break in the records, for the specimen taken April 13, 1904, at Rivera, Veracruz (Piper), seems to be the first and only record for Mexico, and there is none for Central America, though the species is moderately common in Texas south to Corpus Christi (Sennett). A few individuals of this species have been seen in migration on the Pacific coast from San Diego, Calif. (Dwight), to Cape Blossom, Alaska (Grinnell).

*Spring migration.*—The knot arrives on the United States coast in April, but the larger flocks come about the middle of May, and there is no apparent difference in the dates for the whole coast from Florida to Massachusetts. An early date is March 28, at Grand Isle, Louisiana (Beyer, Allison, and Kopman). Near the northern limit of the range some dates of arrival are: Point Barrow, latitude  $71^{\circ} 20' N.$ , May 30, 1883 (Murdoch); Fort Conger, latitude  $81^{\circ} 40' N.$ , June 3, 1883 (Greely); Floeberg Beach, latitude  $82^{\circ} 30' N.$ , June 5, 1876 (Feilden), while far to the southward at Winter Island, latitude  $66^{\circ} N.$ , the first was not noted until June 16, 1822 (Parry), and the next year at Igloodik, a few miles farther north, not until June 14 (Parry).

*Fall migration.*—Birds from the north arrive on the coast of Massachusetts, on Long Island, and in some seasons, even on the coast of South Carolina (Wayne), by the middle of July; the first was seen at the Olympiades, Wash., July 7, 1905 (Dawson). It seems scarcely possible that these early arrivals can have bred the same year, for earliest dates of young are in July and that at places 2,000 miles or

more to the northward. August is the month of principal migration from Maine to South America, and this month also witnesses the departure from the breeding grounds. The last one seen at Floeberg Beach was August 29, 1875 (Feilden); Point Barrow, August 17, 1898 (Stone); Homer, Alaska, August 23, 1901; Winter Island, Melville Peninsula, August 17, 1822 (Greely). During the summer of 1822 the entire stay of the knot on Winter Island was only sixty-two days—one of the shortest nesting periods of any species.

**Purple Sandpiper.** *Arquatella maritima* (Brünn.).

**Breeding range.**—The purple sandpiper is principally a bird of the Old World, breeding on the Arctic coast and islands from north-western Siberia to Iceland. In Greenland it is known on the east coast to Shannon Island, latitude 75° N. (Schalow); and on the west to Thank God Harbor, 81° 40' N. (Bessels); and probably it breeds at least as far north as latitude 72°. A few were seen at Fort Conger, on Grinnell Land (Greely); several at various times in the fall around Wellington Channel (McCormick); and the species was found common in summer on Banks (Armstrong) and Melville (Ross) islands. The Banks Island record at latitude 74° N., longitude 118° W., marks the extreme northwestern range of the species. To the westward of this it is replaced by *couesi*. The southern limit of the breeding range appears to extend from the southern end of Greenland to the base of the Melville Peninsula, and possibly to the northern shores of Hudson Bay. The species breeds most commonly on the shores of Baffin Bay and Davis Strait.

**Winter range.**—The purple sandpiper remains the farthest north in winter of any of the shorebirds. It is said to winter sometimes even in southern Greenland (Hagerup), and it is common in winter from Nova Scotia (Sharpe) and New Brunswick (Macoun) southward to the coast of Rhode Island (Howe and Sturtevant). It is a rare but regular winter visitant to Long Island, New York (Dutcher), and has occurred casually thence south to the Bermudas (Reid), Georgia (Sennett), and Florida (Scott). The species is rare anywhere away from the ocean, but has been noted a few times in the vicinity of the Great Lakes.

**Spring migration.**—Some dates of spring arrival are: Winter Island, June 10; 1822 (Greely); Igloodik, June 14, 1823 (Greely); Cambridge Bay, June 10, 1853 (Greely); Bay of Mercy, June 3, 1852 (Armstrong); Cumberland Sound, June 4, 1878 (Kumlien); Prince of Wales Sound, Ungava, May 27, 1886 (Payne); west coast of Greenland at latitude 72° N., May 29, 1850 (Sutherland). The last usually desert the New England coast in March.

**Fall migration.**—Occasionally a stray bird appears in September on the New England coast, but the main flocks do not arrive until

November or December. The species is not late in deserting the far North, as evidenced by the following dates of the last ones seen: Thank God Harbor, Greenland, September 11, 1871 (Bessels); Possession Bay, Franklin, September 1, 1818 (Sabine); Wellington Channel, August 28, 1852 (McCormick). At Cumberland Sound a few remained in 1877 until November (Kumlien).

**Aleutian Sandpiper.** *Arquatella maritima couesi* Ridgw.

The western coast of Alaska and the Aleutian Islands seem to be the principal home of the Aleutian sandpiper. It breeds throughout the whole of the Aleutian Chain, east to the Shumagin Islands (Dall); and also to the westward on the Commander Islands of Asia (Stejneger). It winters on the Aleutians and south along the mainland of Alaska to Sitka (Bischoff). A few of the breeding birds of the Commander Islands remain throughout the winter, but most of them go south as far as the Kurile Islands (Sharpe).

Early in August, when the young are strong of wing, great flocks move north and appear on the west coast of the mainland of Alaska, at least as far north as Kotzebue Sound (Nelson); they occur also inland to Nulato (Dall), and on the Asiatic side at least to Plover Bay (Dall). This northward migration takes them also to the Pribilof Islands (Seale). They remain in this northern part of the range until driven south by the gathering ice; the last leave Norton Sound about the middle of October (Nelson). The earliest records of eggs taken on Bering Island are about the middle of May (Stejneger), and on Unalaska Island the first week in June (Reed).

**Pribilof Sandpiper.** *Arquatella maritima ptilocnemis* (Coues).

The name Pribilof sandpiper indicates the principal breeding place, but in addition, the species has been found breeding on the islands of St. Lawrence (Nelson), St. Matthew (Elliott), and Hall (Grinnell). It has been taken from July 17 to August 29 on the shores of Norton Sound (McGregor), but there is nothing to indicate that it breeds in the vicinity, and its occurrence there is probably due to a northward migration after the breeding season. The main winter home has not yet been ascertained, and the only winter records to date are those of a few seen in December and January at Portage Bay, near the base of the Alaska Peninsula (Hartlaub). In spring migration the Pribilof sandpiper has been taken April 1-14 at Nushagak, Alaska (Palmer), and in fall migration August 5-14 near Unalaska Island (McGregor). Eggs have been found on the Pribilof Islands from June 19 to July 6 (Prentiss).

**Sharp-tailed Sandpiper.** *Pisobia aurita* (Latham).

The breeding range of the sharp-tailed sandpiper is not well known. The bird occurs in summer on the north shore of Siberia at Cape Waukarem (Nelson) and the Chuckchi Peninsula (Palmen), and this

is probably the principal breeding range. The species winters in Australia and New Zealand and migrates through the Commander Islands, Japan, China, and the Malay Archipelago.

All the records for North America seem to be during the fall migration, at which period—crossing to America on the way to its winter home in Asia—it is fairly common in Alaska on the shores of Norton Sound, and has been noted north to Port Clarence and Hotham Inlet (Nelson). It has been taken a few times on the Pribilof Islands, once on Unalaska Island (Bishop), once on Queen Charlotte Islands (Fannin), and once on Vancouver Island (Brooks). The period of occurrence on the coast of America extends from August 17, when the first was seen on the Pribilof Islands (Grinnell), to October 12, the date of the last seen in Norton Sound (Nelson). The two individuals taken December 27, 1897, on Queen Charlotte Islands (Fannin), were probably stragglers.

**Pectoral Sandpiper.** *Pisobia maculata* (Vieill.).

**Breeding range.**—The principal known summer home of the pectoral sandpiper is the coast of northwestern Alaska, from the mouth of the Yukon (Nelson) to Point Barrow (Murdoch). The principal authority on the birds of the Arctic coast east of the Mackenzie is MacFarlane, and he reports that the pectoral sandpiper was rare in the vicinity of Fort Anderson and Franklin Bay, and that he was never able to find the nest. This must have been a local peculiarity of distribution, for Edward A. Preble, of the Biological Survey, found the species abundant in August, 1900, on the barren grounds of the western shore of Hudson Bay; the species is also a common fall migrant on the coast of Ungava (Coues). Undoubtedly all these birds of Keewatin and Ungava nest along the neighboring Arctic coast, where, indeed, the eggs have been taken at Cambridge Bay, Franklin (Collinson).

**Winter range.**—In winter the species passes to southern South America, at least as far south as Port Desire, Argentina, latitude  $40^{\circ} 30' S.$  (Sharpe), and to Antofagasta, Chile,  $23^{\circ} 30' S.$  (Philippi). It winters in northern Argentina (Durnford) and as far north as Bolivia (Salvadori) and Peru (Sharpe). Though confined in summer to the seacoast, yet in its migrations it has been noted in Colorado at 13,000 feet (Morrison), and in its South American winter home it is not uncommon in the mountains to 12,000 feet (Sclater).

**Migration range.**—The pectoral sandpiper has a very pronounced southeastward migration in the fall. How far west the range extends in the Arctics is not yet known, but the bird has been found in late July and August along the northern coast of Siberia as far west as the Taimyr Peninsula (Palmen), and it may sometimes be found on this coast as a breeder. From these far western localities, it starts east and south along the Alaska coast, and a few visit the Pribilof Islands (specimen in United States National Museum) and the eastern

Aleutians (Bishop), but the species is nowhere common on the Pacific coast south of Alaska, showing that most of the Alaskan and Siberian birds cross the Rocky Mountains and migrate southeastward to the winter home. A few pass south along the Pacific coast to the State of Washington (Suckley), and there are two records for California—Mill Valley Junction, September 14, 1896 (Mailliard), and Farallon Islands, September 4, 1884 (specimen in United States National Museum). The species reappears again in Lower California, where it is fairly common during fall migration in the Cape Region (Brewster).

The species is well known as a migrant on the west coast of Greenland as far north as Upernivik, latitude  $73^{\circ}$  (Winge). It is a common migrant throughout the whole of North America east of the Rocky Mountains, and of the West Indies and Central America. It is strangely rare in the northern part of South America, where it seems to be unrecorded in Venezuela and Guiana, and to have been recorded only once from Colombia (Allen). It is common in migration in Ecuador and Brazil.

*Spring migration.*—The start from the South American winter home must be very early—February, or more likely January—for the average date of arrival at Raleigh, N. C., is March 23; earliest March 21, 1889 (Brimley). Raleigh is full 2,000 miles from the nearest boundary of the winter range, and probably these birds had already traveled over 3,000 miles when they appeared at Raleigh. Some other spring dates are: Beaver, Pa., average April 4, earliest April 1, 1890 (Todd); Erie, Pa., March 23, 1895 (Todd); New Orleans, La., March 7, 1896 (Allison); Hidalgo, Tex., March 16, 1890 (Sennett); St. Louis, Mo., March 17, 1884 (Widmann); Chicago, Ill., average of seven years, March 31, earliest March 27, 1897 (Blackwelder); Terre Haute, Ind., average March 26, earliest March 17, 1887 (Evermann); Ottawa, Ontario, average April 30, earliest April 27, 1894 (White); Keokuk, Iowa, average April 1, earliest March 17, 1893 (Currier); Fort Resolution, Mackenzie, May 19, 1860 (Kennicott); Fort Providence, Mackenzie, May 14, 1905 (specimens in collection Biological Survey); Fort Simpson, Mackenzie, May 16, 1904 (Preble); Dawson, Yukon, May 19, 1899 (Cantwell); St. Michael, Alaska, May 24, 1879 (Nelson); Kowak River, Alaska, May 27, 1899 (Grinnell); Point Barrow, Alaska, May 30, 1883 (Murdoch), and May 30, 1898 (Stone). Eggs were secured at Cape Lisburne, Alaska, June 5, 1885 (Woolfe), and at Point Barrow, June 20–July 10, 1883 (Murdoch).

*Fall migration.*—In common with many other shorebirds, the pectoral sandpiper begins its fall migrations in July; indeed, it is probable that some start southward in June, for the average date of arrival on the coast of Mississippi is July 19, earliest July 15, 1903 (Allison); and at New Orleans, La., earliest July 17, 1895 (Blakemore). These birds were already more than 2,000 miles

south of their breeding grounds, and had probably traveled all of this distance, for the pectoral sandpiper is not one of the species whose nonbreeders remain through the summer far south of the nesting grounds. If the fall migration was made at the same speed as the spring migration, about 35 miles per day, these July Gulf coast birds would have had to start on the return trip the middle of May, or earlier than they reach their breeding grounds. The records of this species combined with those of many others seem to indicate that the earliest fall migrants travel at a higher speed than the earliest spring migrants. This high speed in the case of the pectoral sandpiper is continued to South America and brings the first to Argentina by the end of August (Sclater and Hudson).

The regular fall migration of the young birds is a full month later, and they reach the coast of Ungava after the middle of August (Coues). Some late dates are: Northern coast of Siberia, August 20 (Pelzeln); Point Barrow, September 6, 1882 (Murdoch); St. Michael, September 6, 1899 (Osgood); Unalaska Island, October 5, 1899 (Bishop); Nushagak, Alaska, October 15, 1884 (Osgood); southern British Columbia, average October 16, latest October 25, 1905 (Brooks); Terry, Mont., October 21, 1905 (Cameron); Great Bear Lake, August 29, 1903 (Preble); Montreal, average October 25, latest November 1, 1890 (Wintle); Ottawa, Ontario, average October 29, latest November 5, 1895 (White); Lincoln, Nebr., November 4, 1899 (Wolcott); Keokuk, Iowa, November 24, 1900 (Currier); Carlisle, Pa., November 2, 1844 (Baird); Raleigh, N. C., November 15, 1894 (Brimley). A gunner near Newport, R. I., who shot 2,337 birds in 1867-1874, killed most of them between August 10 and October 10—extreme dates July 16, 1870, and October 20, 1874 (Sturtevant).

**White-rumped Sandpiper.** *Pisobia fuscicollis* (Vieill.).

**Breeding range.**—The only nests and eggs of the white-rumped sandpiper so far reported are those taken near the coast of Franklin Bay, Mackenzie, and on the neighboring Barren Grounds (MacFarlane). The species was seen near Cumberland Sound July, 1878 (Kumlien), under such conditions as to make it probable that it was breeding, and is recorded as breeding at Cape Fullerton, Hudson Bay (Low). Many specimens have been taken on the west coast of Greenland from near the southern end north to Upernivik, latitude 73° (Winge), but there is no proof that any of these were breeding. At Point Barrow, Alaska, the species was noted June 6-July 6, 1883 (Murdoch), and June 2-14, 1898 (Stone), but again there is no certainty of breeding. None of the expeditions that lived and collected on Boothia Peninsula and Melville Peninsula mention this species, and it is not known to breed south of Hudson Strait. It is evident, therefore, that the thousands of individuals of this species are crowded during the breeding season into a rather narrow belt of tundra

extending from near the mouth of the Mackenzie east to the southern end of Baffin Land.

*Winter range.*—Few species of shorebirds have so many records for Patagonia as the white-rumped, and this is also one of the species that is erroneously said to breed in the Southern Hemisphere. It winters abundantly from Paraguay and Argentina to the Falkland Islands (Sclater and Salvin) and the southern coast of Tierra del Fuego (Schalow). It is rare or casual on the coast of Chile (Gay) and unknown on the rest of the western coast of South America, except one seen at Chorillos, Peru (Taczanowski), and one taken October 12, 1864, near Huanaracama, Peru (specimen in United States National Museum).

*Migration range.*—During migration the white-rumped sandpiper is common along the whole eastern coast of South America, in the West Indies, and in the United States east of the Rocky Mountains. The western edge of the migration route extends from the upper Mackenzie through western Saskatchewan and eastern Colorado to the coast of southern Texas and then turns east to northern Yucatan and the island of Trinidad. The species is only an accidental visitant to Mexico (Salvin), Central America, and the whole of north-western South America. Accidental once in California (Bryant) and several times in Europe.

*Spring migration.*—The species arrives in Cuba in April (Gundlach) and has been recorded in northern Yucatan April 15 (Salvin). Nearly all the dates of arrival in the United States are in May, from Florida to Maine and from Massachusetts to Colorado. The first was seen at Indian Head, Saskatchewan, May 9, 1892 (Macoun); Fort Chipewyan, Alberta, May 30, 1893 (Russell); Fort Resolution, Mackenzie, May 19, 1860 (Kennicott); Cape Fullerton, Hudson Bay, May 22, 1904 (Eifrig). There are indications that the larger number pass north in spring by way of the Mississippi Valley and return in fall along the Atlantic coast; but some individuals are found on the Atlantic coast in spring, though rare north of Virginia, and a few occur in the eastern Mississippi Valley in fall. The most surprising feature of this bird's migration is its late stay in spring south of its breeding grounds. Near Cape Horn, South America, it was abundant the winter of 1882-83 and remained until March 7, 1883 (Oustalet). It remains in southeastern Argentina until late April (Holland), and a single specimen was taken at Colonia, Uruguay, in June (Sharpe). The species remains regularly in Brazil until May (Pelzelin); one was taken on Inagua, Bahamas, May 27, 1879 (Cory); Amelia Island, Florida, May 30, 1906 (Worthington); Erie, Pa., June 4, 1875 (Sennett); Stafford County, Kans., June 6, 1907 (Peabody); Waukegan, Ill., June 9, 1876 (Nelson); Toronto, Ontario, June 21, 1898 (Nash); and at Indian Head, Saskatchewan, the last did not leave for the north until July 1, 1892 (Macoun).

*Fall migration.*—By early July the species is already moving south and arrived soon after July 1, 1886, at Prince of Wales Sound, Ungava (Payne), just south of the breeding grounds. During the month of July the van appears all along the New England coast, and even reaches Barbados (Feilden). August finds the species in Brazil (Pelzeln), and the collectors near Cape Horn in 1882 recorded the arrival of the first September 9 (Oustalet).

The main part reaches the northern United States in August, usually about the second week; the last leave the breeding grounds soon after the 1st of September, and the birds are seldom seen on the New England coast after the middle of October. One was taken at Ossining, N. Y., October 21, 1879 (Fisher), and a late migrant was taken at Lake Drummond, Virginia, November 5, 1898 (Fisher).

*Baird Sandpiper.* *Pisobia bairdi* (Coues).

*Breeding range.*—The Baird sandpiper has been found breeding at Point Barrow, Alaska (Murdoch), in the vicinity of Franklin Bay, Mackenzie (MacFarlane), and at Cambridge Bay, Franklin (Collinson). These localities probably represent the real extremes of the breeding range, for east or west of these limits the species is known very rarely even in migration.

*Winter range.*—During migration the Baird sandpiper has been noted near the summit of one of the highest mountains of Colorado at 14,000 feet (Drew). The same tendency to seek a high altitude is shown in the winter home, for this species has been taken repeatedly in the high mountains of northern Chile at 10,000 to 12,000 feet, and one specimen was secured at over 13,000 feet altitude (Sclater). Chile seems to be the principal winter home of the species, and it has been recorded here south to Talcahuano, latitude  $36^{\circ} 30' S.$  (Sharpe). It is said to have occurred in Patagonia (Carbajal), but no definite locality is given, and in Argentina it seems not to have been recorded south of Buenos Aires (Sclater and Hudson).

*Migration range.*—The route the Baird sandpiper traverses between its winter and summer homes is yet to be determined. In spring migration the species is practically unknown east of the Mississippi River, and is abundant on the coast of Texas, on the plains, and in the Rocky Mountain region. Though many individuals occur in the eastern United States in fall, yet the bulk retraces its spring course and leaves the United States to the southward of the plains region. It has been noted in a few places in Mexico in fall: Colonia Garcia, Chihuahua, September 4; Chihuahua City, October 3 (Nelson); San Jose del Cabo, September 3–13 (Brewster); Janos River, Chihuahua, September 5 (Wolfe); Las Vigas, Jalapa, September (Sharpe); and Zacatecas, August 16 (Sharpe); here the record ends. The species is not recorded for Guatemala, Honduras, or Nicaragua. It is a common fall migrant in Ecuador (Salvadori and Festa), but the only records

between Mexico and Ecuador are: Volcano Irazu, Costa Rica, June 8 (Cherrie); La Estrella de Cartago, Costa Rica, November 5, 1907 (Carriker); and Medellin, Colombia (Sclater and Salvin), without date of observation.

Not many years ago the Baird sandpiper was considered merely accidental on the Atlantic coast. The past few years have witnessed a great increase of data. It is now known to be a regular and not rare migrant east to Lake Huron (Wood), Lake Erie (Todd), and the western end of Lake Ontario (Nash), and there are 50 or more printed records for the Atlantic coast region, from Four Mile Run, Va. (Matthews), north to Digby, Nova Scotia (Macoun). What becomes of these Atlantic coast birds is not yet known, for the species seems to be unrecorded in the United States south of the Ohio River and east of Mississippi, and is not known in the West Indies. It ranges regularly west to British Columbia (Brooks), but to the southward the flocks seem to pass inland west of the Sierra and are common in Nevada (Ridgway) and Arizona (Henshaw), but rare in California, where it has been taken at Point Pinos (Mailliard) and September 8, 1904, at Pacific Beach (Bishop).

*Spring migration.*—The Baird sandpiper is a much earlier migrant than its eastern relative, the white-rumped. It appears on the coast of Texas in early March (Brown); the average date of arrival in central Nebraska is March 24, earliest March 19, 1890 (Powell); Loveland, Colo., March 29, 1890 (Smith); southern British Columbia, April 29, 1889, and 1905 (Brooks); Indian Head, Saskatchewan, May 9, 1892 (Macoun); Fort Resolution, Mackenzie, May 19, 1860 (Kennicott); near Dyer, Alaska, May 15, 1882 (Hartlaub); Kowak River, Alaska, May 20, 1899 (Grinnell); Point Barrow, Alaska, average of three years May 29, earliest May 28, 1898 (Stone). The date of arrival at Point Barrow is worthy of notice, for at this time the birds' breeding grounds on the tundra were covered deep with snow, and it had to wait some weeks before it could begin nesting. The earliest eggs at Fort Anderson were found June 24, 1864 (MacFarlane); the next year, young were noted July 5, and downy young were taken at Point Barrow July 16, 1898 (Stone).

The species remains in Chile until the last of March (Lane), and is common in Texas to the middle of May (Lloyd). A late migrant was taken June 1, 1903, at Iguala, Guerrero (Nelson and Goldman). The last usually leave Nebraska before the first of June, but in 1900 one was seen at Lincoln on June 29 (Wolcott). The last was noted at Indian Head, Saskatchewan, June 2, 1892 (Macoun), and at Fort Chipewyan, Alberta, June 1, 1893 (Russell).

*Fall migration.*—Several flocks already in fall migration were seen at Great Slave Lake, Mackenzie, July 10, 1901 (Preble). Since the earliest young are not hatched until the first week in July, it is evident

that these flocks of July 10, already several hundred miles south of the breeding grounds, must consist either of barren birds or of those that had suffered loss of their eggs. In southern British Columbia, the average date of arrival is August 11, earliest August 6, 1888 (Brooks); near Monterey, Calif., August 25, 1897 (Mailliard); southern Saskatchewan, July 17, 1906 (Bishop); southern Manitoba, July 23, 1881 (Macoun); Lincoln, Nebr., August 9, 1900 (Wolcott); southern Ontario, July 28, 1891 (Nash); Locust Grove, N. Y., August 18, 1885 (Henshaw); Boston Harbor, August 27, 1870 (Henshaw); Montauk, N. Y., August 14, 1907 (Braislin). In September it reaches its winter home in southern South America.

The last were seen at Point Barrow, Alaska, August 12, 1883 (Murdoch), and September 4, 1897 (Stone); southern British Columbia, September 15, 1903 (Brooks); Fort Lyon, Colo., September 28, 1885 (Thorne); Lincoln, Nebr., November 3, 1900 (Wolcott); southern Ontario, October 20, 1893 (Elliott); New Haven, Conn., October 28, 1887 (Woodruff); Galapagos Islands, October 6, 1897 (Rothschild and Hartert).

**Least Sandpiper.** *Pisobia minutilla* (Vieill.).

**Breeding range.**—The least sandpiper nests in the far north to northern Ungava (Turner); at Cambridge Bay in southern Franklin (Collinson); the coast of Mackenzie (MacFarlane); and Kotzebue Sound, Alaska (Grinnell). Unlike most of the Arctic breeding shorebirds, it breeds also quite far south to Sable Island (Oates); Magdalen Islands (Job); northeastern Quebec (Audubon); upper Hamilton River, Ungava (Low); Fort Churchill, Keewatin (Preble); Lake Marsh, southern Yukon (Bishop); and in Alaska south to Yakutat Bay (Merriam). The western limit of the breeding range in Alaska is not yet definitely settled.

**Winter range.**—The species is recorded without exact locality from Chile (Salvin), has been taken at several places in Peru (Taczanowski), and ranges south in Brazil to Pernambuco (Allen). Thence it is known throughout northern South America, Central America, Mexico, and the West Indies, the coast of Georgia (Helme), rarely in winter to North Carolina (Bishop), southern Texas (Merrill), southern Arizona (specimen in United States National Museum), and southern California, north at least to Owen Lake (Fisher) and Humboldt Bay (Townsend).

**Migration range.**—Beyond the known breeding range, the least sandpiper is found in fall on the west coast of Greenland north to Godhaven, latitude 69° (Walker); at Plover Bay, Siberia (Bean). It occurs during most if not all the summer on the Alaska Peninsula (Osgood) and on the Aleutian Islands west to Unalaska (specimen in United States National Museum).

**Spring migration.**—Though wintering so far north, this species is one of the later shorebirds to migrate. Most of the migrants cross

the United States in early May, as shown by the following dates of arrival: Long Island, New York, average May 4, earliest April 21, 1906 (Latham); eastern Massachusetts, average May 8; city of Quebec, average May 2, earliest April 28, 1900 (Dionne); Chicago, Ill., average May 8, earliest May 4, 1898 (Gault); Oberlin, Ohio, average May 12, earliest May 8, 1905 (Jones); southern Ontario, average May 15, earliest May 8, 1889 (McIlwraith); Ottawa, Ontario, average May 18, earliest May 10, 1888 (White); Onaga, Kans., average May 11, earliest May 9, 1904 (Crevecoeur); southern Saskatchewan, average May 17, earliest May 12, 1903 (Harvey); Fort Resolution, May 19, 1860 (Kennicott); Fort Providence, May 15, 1905 (Mills); Fort Simpson, May 17, 1904 (Preble); Loveland, Colo., average April 21, earliest April 19, 1890 (Smith); Cheyenne, Wyo., average April 28, earliest April 23 1888 (Bond); Newport, Oreg., average April 29, earliest April 21, 1901 (Bretherton); southern British Columbia, average April 22, earliest April 20, 1905 (Brooks); Nulato, Alaska, May 11, 1867 (Dall); Kowak River, Alaska, May 15, 1899 (Grinnell).

Eggs were taken near Fort Anderson, Mackenzie, June 21, 1862; June 24, 1863, and June 30, 1864 (MacFarlane); Yakutat Bay, Alaska, June 21, 1899 (Merriam); downy young at Lake Marsh, Yukon, July 2, 1899 (Bishop), and an egg ready to lay at the Kowak River, Alaska, June 1, 1899 (Grinnell).

*Fall migration.*—The following dates of arrival show how very early some individuals of the species must start southward: Sitka, Alaska, common July 2, 1896 (Grinnell); southern British Columbia, July 2, 1889 (Brooks); North Dalles, Wash., July 4, 1897 (Fisher); near San Diego, Calif., July 13, 1894 (Mearns); Fort Bridger, Wyo., July 13, 1858 (Drexler); Lincoln, Nebr., July 14, 1900 (Wolcott); Detroit, Mich., July 9, 1905 (Swales), July 7, 1906 (Taverner); near Toronto, Ontario, July 4, 1891 (Nash); Lexington, Ky., July 16, 1905 (Dean); Long Island, New York, average July 8, earliest July 6, 1898 (Worthington); Bahamas, July 16, 1903 (Riley), July 18, 1904 (Allen); the Lesser Antilles, the middle of July (Feilden); off the coast of Venezuela, July 23, 1892 (Hartert).

Some dates of the last seen are: Cape Blossom, Alaska, August 10, 1898 (Grinnell); southern British Columbia, average September 11, latest September 18, 1903 (Brooks); Aweme, Manitoba, average September 4, latest September 26, 1899 (Criddle); Long Island, New York, September 17, 1905 (Latham); Erie, Pa., October 3, 1895 (Todd); Back River, Maryland, November 3, 1894 (Kirkwood).

**Long-toed Stint.** *Pisobia damacensis* (Horsf.).

The long-toed stint is a species of eastern Asia, accidental in North America. It breeds in eastern Siberia, Kamchatka, Bering Island, and south to the Kurile Islands; west probably to the valley of the Lena River. This statement of breeding range is based on

the occurrence of the species in summer, since the nest and eggs are still unknown. The species passes south for the winter, through China and Japan, to Australia, the Malay Archipelago, Burma, and India. The only record in North America is of a single specimen taken June 8, 1885, on Otter Island, Alaska (Ridgway).

[Cooper Sandpiper. *Pisobia cooperi* (Baird).

The Cooper sandpiper is known only from the single specimen now in the National Museum, taken in May, 1833, on Long Island. The status of the species is still in doubt.]

Dunlin. *Pelidna alpina* (Linn.).

The dunlin, an Old World species, has been noted a few times in North America. A specimen was taken October 20, 1842, at Washington, D. C., and two days later a second was secured (Smith); one was captured September 15, 1892, at Shinnecock Bay, Long Island, New York (Young), and one August 11, 1900, at Chatham, Mass. (Howe and Allen). There are less certain records of its occurrence in the region of Hudson Bay (Blakiston). There seems to be no sure record for Greenland, though the regular breeding range extends west to England, Scotland, and Iceland. The species breeds east to Turkestan and probably to the valley of the Yenisei, and north to the islands of the Arctic coast. It winters from Great Britain and the Caspian Sea south to northern Africa and India.

Red-backed Sandpiper. *Pelidna alpina sakalina* (Vieill.).

*Breeding range.*—The red-backed sandpiper has two well-defined breeding areas corresponding in general to the Atlantic and Pacific winter ranges. The birds of the Atlantic coast breed from north-eastern Ungava (Weiz) and Cape Fullerton, Hudson Bay (Low), north to Bellot Strait (McClintock). A few (of either this form or the last) breed on the west coast of Greenland, from which country there are eggs in the United States National Museum. The birds of the Pacific coast breed in Alaska from the mouth of the Yukon (Nelson) north to Point Barrow (Murdoch), and on much of the northern coast of Siberia west possibly to Yenisei River (Seeböhm). The region of intergradation along the coast of Siberia is not yet definitely determined. These two breeding areas are separated by nearly 1,500 miles of Arctic coast, from Point Barrow to the Boothia Peninsula, and throughout this whole region there seems to be no certain record of the occurrence of the red-backed sandpiper. If it does occur, it must be very rare, and the probability that it does not is increased by the fact that the species is not known as a migrant in the region immediately to the south. It is abundant as a migrant along the west coast of Hudson Bay (Preble) and has been taken at Dawson, Yukon (Cantwell), but as yet is unrecorded in the intervening districts.

*Winter range.*—Few of the shorebirds go so short a distance to the southward as the red-backed sandpiper. It is common in winter

as far south as central Florida (Scott), but is unknown in the Bahamas and the West Indies. On the coast of Texas it ranges to the mouth of the Rio Grande (Merrill), but is not yet known in northeastern Mexico. On the Pacific coast it is abundant south to southern Lower California (Belding), but seems not to pass farther south. The only record south of the region just outlined is that of a specimen, undoubtedly a straggler, taken May 23, at Momotomba, Nicaragua (specimen in British Museum). During the winter the species remains north to the coasts of North Carolina (Bishop), New Jersey, casually (Stone), Louisiana (Beyer), Texas (Carroll), and at least to central Washington (Bowles). The Siberian birds of this form winter from Japan and China to the Malay Archipelago.

*Spring migration.*—Most of the spring movements occur in May, but a few early birds press northward in April: Long Beach, New Jersey, April 17, 1877 (Scott); Long Island, New York, April 3, 1882 (Chapman); Erie, Pa., April 21, 1900 (Todd). On the Atlantic coast north of Massachusetts the species is not so common in spring as in fall, while around the Great Lakes the reverse is the case. The main body of the Atlantic coast birds seem to reach their breeding grounds by way of the Great Lakes and Hudson Bay. Along this route they are late migrants, reaching southern Ontario on the average May 20, earliest May 13, 1905 (Taverner).

The Pacific coast birds appeared in southern British Columbia April 25, 1888 (Brooks), and April 26, 1889 (Brooks); one was seen as early as April 2, 1897, at Howcan (Cantwell), in the extreme southern part of Alaska. Other dates of spring arrival are: Fort Kenai, May 16, 1869 (Osgood); Kigulik Mountains, May 17, 1905 (Anthony); Dawson, Yukon, May 24, 1899 (Cantwell); Point Barrow, Alaska, May 31, 1882 (Murdoch), May 29, 1883 (Murdoch), and June 2, 1898 (Stone).

None were noted in Lower California after May 10 (Belding), but in central Florida they have been recorded as late as June 2, 1886 (Scott), and in southern Ontario the average date of the last seen is June 4, latest June 13, 1891 (Nash).

Eggs have been taken at the mouth of the Yukon, June 6, 1879 (Nelson); Cape Prince of Wales, June 27, 1898 (Grinnell); and at Point Barrow, June 22, 1883 (Murdoch). At this last locality the eggs in some seasons must be laid earlier than the above date, for in 1898 downy young were taken July 6 (Stone).

*Fall migration.*—Early fall migrants were passing south July 19, 1900, along the west shore of Hudson Bay, near York Factory (Preble), and two weeks later they were enormously abundant, showing that this is one of the principal routes in fall migration. Since the species is not common in the Mississippi Valley and is comparatively rare in western Ontario in the fall, it is evident that many of these Hudson

Bay birds turn eastward to the Atlantic coast. An early arrival appeared on Long Island, New York, July 17, 1897 (Worthington), but the usual time of arrival is a month or more later; Hayward, Calif., August 3, 1889 (Emerson); Point de Monts, Quebec, August 28, 1883 (Merriam); Plymouth, Mass., September 17, 1852 (Browne); Erie, Pa., September 21, 1875 (Sennett); Washington, D. C., September 25, 1894 (Hasbrouck).

The last deserted the breeding grounds at Point Barrow, Alaska, September 7, 1882 (Murdoch); September 4, 1897 (Stone). The last have been noted at St. George Island, Alaska, October 3, 1899 (Bishop); Bering Island, October 25, 1884 (Grebnitsky); Chicago, Ill., November 3, 1906 (Ferry); Oberlin, Ohio, October 27, 1906 (Jones); St. Clair Flats, Michigan, November 20, 1904 (Blain); Ottawa, Ontario, average October 4, latest October 29, 1889 (White); Portland, Me., November 11, 1906 (Eastman); Barnstable, Mass., December 23, 1903 (Howe); Comox, British Columbia, December 5, 1903 (Brooks).

**Curlew Sandpiper.** *Erolia ferruginea* (Brünn.).

The curlew sandpiper breeds only in the Eastern Hemisphere, but wanders not infrequently to the Atlantic coast of North America. The only eggs so far known were taken July 3, 1897, in the delta of the Yenisei River, Siberia (Newton), and June 24–July 6, 1900, on the northwestern coast of the Taimyr Peninsula, Siberia (Dresser). It is probable that all Greenland records for this species are erroneous, and that the only reliable record in Arctic America is that of the single individual taken June 8, 1883, at Point Barrow, Alaska (Murdoch). On the Atlantic coast of America it has been recorded about twenty times from Halifax, Nova Scotia (Jones), to Cape May, N. J. (Abbott). A few dates are in May, but the larger part are in the fall from August to October. One specimen was taken about 1886 in the interior at Toronto, Ont. (Fleming). The species has been recorded from Grenada Island, West Indies (Cory), and there is a specimen in the British Museum said to have been taken in eastern Patagonia.

In winter the curlew sandpiper ranges south to southern Africa, India, the Malay Archipelago, and Australia. During migration it has been noted in the Philippines and China, and west to Great Britain.

**Spoon-bill Sandpiper.** *Eurynorhynchus pygmeus* (Linn.).

The spoon-bill sandpiper inhabits the Eastern Hemisphere and ranges in summer to northeastern Siberia. It migrates through Japan and China and winters as far south as Burma and India. One was taken in 1849 on the Choris Peninsula of Alaska—the only record for the Western Hemisphere.

**Semipalmated Sandpiper.** *Ereunetes pusillus* (Linn.).

**Breeding range.**—The semipalmated sandpiper breeds in Ungava at Okak (Crandall) and south to Fort George (Drexler), and also on the Barren Grounds from Hudson Bay (Eifrig) west to Franklin Bay (MacFarlane), along the Arctic coast to Kotzebue Sound, Alaska (Grinnell), and south on the western coast of Alaska to St. Michael (specimens in United States National Museum).

**Winter range.**—It winters mainly in eastern South America, south to Patagonia (latitude 43° S.) (Seebohm), and thence north through Central America and the West Indies to eastern Mexico (Sumichrast), southern Texas (Refugio County; Carroll), Florida (Scott), and the coast of Georgia (Helme) and South Carolina (specimen in United States National Museum).

**Migration range.**—The semipalmated sandpiper is a rare spring but an abundant fall migrant along the whole Atlantic coast. It is a common fall migrant through the Bermudas (Hurdis), Bahamas (Bryant), and the West Indies east of Cuba. It is common both spring and fall in the Mississippi Valley, becoming less common westward to the eastern base of the Rocky Mountains, and west of the mountains to western British Columbia (Brooks), Sitka, Alaska (Bischoff), Cook Inlet (Chapman), Norton Sound (McGregor), St. Paul Island (Palmer), and the coast of northeastern Siberia (Nelson). It has occurred in migration on the coast of Peru (Salvin).

**Spring migration.**—Almost all the spring records for the Atlantic coast are in May, while migration in the Mississippi Valley begins in April: Camden, Ind., average of three years April 21, earliest April 18, 1886 (Groninger); Keokuk, Iowa, average of eight years April 30, earliest April 19, 1898 (Currier); Fort Lyon, Colo., April 25, 1886 (Thorne); Indian Head, Saskatchewan, May 16, 1892 (Macoun); Fort Chipewyan, Alberta, May 24, 1901 (Preble); Great Bear Lake, Mackenzie, May 24, 1826 (Richardson); Kowak River, Alaska, May 29, 1899 (Grinnell). Nonbreeding birds are found here and there in summer from Wisconsin (Kumlien and Hollister) to Massachusetts (Howe and Allen).

Eggs have been taken at Fort George, Ungava, June 24, 1860 (Drexler); Franklin Bay, Mackenzie, June 30, 1864 (young July 5, 1865), (MacFarlane); St. Michael, Alaska, June 9, 1880 (specimens in United States National Museum); and young just hatched at Cape Blossom, Alaska, June 30, 1898 (Grinnell).

**Fall migration.**—Like so many other sandpipers the semipalmated begins to move south so early that it appears in the United States in July; southern Mississippi, average of three years July 16, earliest July 10, 1905 (Brodie and Kopman); Fernandina, Fla., July 14, 1906 (Worthington); Porto Rico, August 11, 1901 (Bowdish); La Guaira, Venezuela, August 10 (Robinson and Richmond), and Marajo, Brazil,

August 4 (Allen). Specimens were taken July 3, 1907, at Coronado de Terraba, Costa Rica (Carriker), but these may have been non-breeders that had not made the northward journey. Young birds migrate about a month later, and it is probably these that afford the following average dates: North River, Prince Edward Island, August 8 (Bain); Long Island, New York, August 10 (Worthington); Beaver Pa., August 14 (Todd); Keokuk, Iowa, August 18 (Currier).

The average date of the last one seen at Point Barrow, Alaska, is August 15, latest August 18, 1882 (Murdoch); Herschel Island, Yukon, August 2, 1894 (Russell); York Factory, Keewatin, August 26, 1900 (Preble); Ottawa, average of the last one seen September 9, latest September 17, 1892 (White); Lewiston, Me., October 17, 1900 (Johnson); Ossining, N. Y., October 20, 1885 (Fisher); Washington, D. C., October 26, 1887 (Richmond).

**Western Sandpiper.** *Ereunetes mauri* Cabanis.

**Breeding range.**—The western sandpiper's breeding range, as at present known, is a narrow strip along the northwestern coast of Alaska from the mouth of the Yukon (specimens in United States National Museum) to Cape Prince of Wales (Grinnell).

**Winter range.**—Though breeding only on the northwest coast, this sandpiper is common in winter on the Atlantic coast from North Carolina (Bishop) to Florida (Scott). This long migration across the continent to the southeastward from the breeding grounds is very remarkable, and is not paralleled in the case of any other shorebird. It is, however, comparable with the migration of several species of ducks from the Mackenzie Valley to Chesapeake Bay. The species also winters from La Paz, Lower California (specimen in National Museum), to southern Mexico (Lawrence), Guatemala (Sharpe), Colombia (Ridgway), and Venezuela (Robinson), and undoubtedly to the Lesser Antilles, but its distribution in the West Indies is not yet known with any accuracy.

**Migration range.**—In passing from the summer to the winter home, the western sandpiper comes east to the Atlantic coast at least as far north as Massachusetts (Henshaw), and sometimes is quite common in the fall on Long Island (Braislin) and the coast of New Jersey (Baily). The strange fact is that there are no corresponding records from the interior to indicate the route by which these birds reach New England. The species seems not to be known north of southern Wisconsin (Kumlien and Hollister), Colorado (Osburn), and southern Wyoming (specimen in National Museum), while in all of the Mississippi Valley between the river and the Rocky Mountains the species is so very rare as to make it improbable that any large part of the New England birds migrate through this section. In fall migration the species is known west in the Aleutians to Unalaska Island (Palmer).

*Spring migration.*—Along the Atlantic coast the species is almost unknown in spring north of its winter range; the few known occurrences are in May. To the westward some dates of spring arrival are: Galveston, Tex., March 24, 1891 (Singley); San Pedro River, Arizona, April 17, 1902 (Howard); Monterey, Calif., April 6, 1903 (Breninger); Redwood City, Calif., April 14, 1907 (Carriger and Pemberton); Corvallis, Oreg., April 21, 1899 (Woodcock); southern British Columbia, April 26, 1889, and April 20, 1905 (Brooks); Fort Kenai, Alaska, May 12, 1869 (Bischoff); St. Michael, May 28, 1874 (Turner).

Most of the individuals have left southern Lower California by May 10 (Belding) and the northern part by the middle of the month (Kaeding). The species was still present at Owen Lake, California, June 1, 1891 (Fisher). Eggs have been found at the mouth of the Yukon June 5 (specimens in United States National Museum) and near Cape Prince of Wales, June 28, 1898 (Grinnell).

*Fall migration.*—The first fall migrants were noted at Tulare Lake, California, July 7–8, 1907 (Goldman), and the species was taken off the coast of Venezuela July 7, 1895 (Robinson). The first of these records probably represents birds in migration; the other, non-breeders that had summered far south of the breeding grounds. Some other fall records are: Southern British Columbia, average of five years August 14 as the date of fall arrival (Brooks); Semiahmoo Bay, Washington, July 15, 1857 (Kennerly); Santa Barbara, Calif., July 3, 1875 (Sharpe); Fort Bridger, Wyo., July 13, 1858, (Drexler); near Arco, Idaho, July 25, 1890 (Merriam); Rockport, Tex., August 12, 1905 (Howell); Monomoy Island, Massachusetts, July 19, 1888 (Brewster); Charleston, S. C., about July 8 (Wayne); Haiti, July 11, 1883 (Stone); San Mateo, Tehuantepec, August 7, 1869 (specimen in United States National Museum). The latest date in southern British Columbia is September 11, 1889 (Brooks); Hayward, Calif., November 4, 1889 (Emerson); Monomoy Island, Massachusetts, September 19, 1888 (Brewster); Cape May County, N. J., September 15, 1895 (Baily); Washington, D. C., September 22, 1894 (Hasbrouck).

**Sanderling.** *Calidris leucophaea* (Pallas).

*Breeding range.*—The sanderling is a cosmopolite, breeding and wintering in both hemispheres. It is known to breed north to Point Barrow, Alaska (Stone), Melville Island (Fisher), Grinnell Land (Feilden), both coasts of Greenland (Bessels and Winge), the Taimyr Peninsula, Siberia (Walter), and undoubtedly breeds on the New Siberian Islands (Newcombe). It breeds south to Iceland (Oates), to Cape Fullerton, Hudson Bay (Low), and to Franklin Bay, Mackenzie (MacFarlane).

*Winter range.*—Some sanderlings pass in winter to central Argentina (Tambo Point, 44° S.: Durnford), and to Talcahuano, central Chile (Sharpe), 8,000 miles from the nearest breeding grounds; while

others remain as common winter residents on the Atlantic coast of the southeastern United States north to North Carolina (Smithwick) and casually even to Massachusetts (Mackay). The species winters on the coast of Texas (Merrill) and on the Pacific coast regularly to central California (Cooper) and occasionally to Washington (Cooper and Suckley).

It occurs in fall migration on the Hawaiian Islands, where it has been taken from September 25 to October 14 and where a few may winter (Henshaw).

The sanderlings of the eastern hemisphere winter from the Mediterranean and Japan south to southern Africa, the Malay Archipelago, and Oceania.

*Migration range.*—The sanderling is common on the coasts of the world and on the larger inland waters. It is abundant on both coasts of North America and common on the Great Lakes. It has been recorded in migration from almost every State of the Union, but is quite rare in all the district between the Great Lakes and the Pacific coast.

*Spring migration.*—The northward movement begins in March, bringing the species the latter part of this month to the New England coast and to the central Mississippi Valley. Further advance is so slow that the sanderling is among the later birds to arrive at the breeding grounds, which are reached the first week in June. Some dates of spring arrival are: Fort Simpson, Mackenzie, May 29, 1904 (Preble); Point Barrow, Alaska, latitude  $71^{\circ}$ , June 2, 1882 (Murdoch), June 6, 1898 (Stone); Prince of Wales Strait,  $73^{\circ}$ , June 7, 1851 (Armstrong); Bay of Mercy,  $74^{\circ}$ , June 3, 1852 (Armstrong); Winter Island,  $66^{\circ}$ , June 10, 1822 (Lyon); Igloodik,  $69^{\circ}$ , June 16, 1823 (Parry); Grinnell Land,  $82^{\circ} 33'$ , June 4, 1876 (Feilden); west coast of Greenland at  $72^{\circ}$ , May 29, 1850 (Sutherland); at  $78^{\circ}$ , June 5, 1854 (Kane); Taimyr Peninsula, Siberia,  $74^{\circ}$ , June 4 (Seebohm). Specimens were taken in Chile in May (Schalow); in British Honduras May 18–20 (Salvin); southern Florida, May 25 (Scott); the coast of New Jersey, June 13 (Abbott). The species remains regularly on the New England coast and about the Great Lakes until the first week in June. The fact that nonbreeders remain through the summer far south of the nesting grounds has probably furnished the basis for the reports of the breeding of the species south of the Arctic coast.

The first eggs known to science were taken June 29, 1863, near Franklin Bay, Mackenzie (MacFarlane), a locality where the species is very rare. The most northern known eggs were taken June 24, 1876, near the north coast of Grinnell Land, at latitude  $82^{\circ} 33'$  (Feilden). Eggs were taken in July at Thank God Harbor, Greenland (Bessels), and both late June and early July on the Taimyr Peninsula, Siberia (Walter).

*Fall migration.*—The sanderling was seen off the coast of Venezuela July 7, 1895 (Robinson), but regular fall migration does not begin until some weeks later, as shown by the following dates of fall arrival, which in each case are considerably earlier than the average: Big Stick Lake, Saskatchewan, July 19, 1906 (Bent); Lincoln, Nebr., August 7, 1900 (Wolcott); Toronto, Ontario, July 16, 1898 (Nash); Newfoundland, August 2, 1887 (Palmer); Erie, Pa., July 27, 1900 (Todd); Long Island, New York, July 20, 1900 (Scott); San Mateo, Tehuantepec, August 5, 1869 (Sumichrast). The last was seen at Point Barrow, August 27, 1897 (Stone); St. Michael, Alaska, September 11, 1899 (Bishop); Homer, Alaska, August 29, 1901 (Chapman); Prince of Wales Strait, August 30, 1850 (Armstrong); Grinnell Land, about August 31, 1882 (Greely); Prince Edward Island, October 30, 1887 (Bain); Montreal, Canada, October 7, 1889 (Wintle); Lincoln, Nebr., October 4, 1898 (Bruner, Wolcott, and Swenk); Ottawa, Ontario, October 22, 1887 (White); Erie, Pa., November 17, 1902 (Todd).

**Marbled Godwit.** *Limosa fedoa* (Linn.).

*Breeding range.*—Formerly the marbled godwit was a common breeder in northern Nebraska (Say), in northern Iowa south to about latitude 43° (Preston), and a few undoubtedly nested in Wisconsin, at about the same latitude (Kumlien and Hollister). It is not probable that the species now breeds in either State, and the principal summer home at the present time is from northern North Dakota (Rolle) to the valley of the Saskatchewan (Bent).

*Winter range.*—The species passes south in winter to southern Guatemala (Salvin) and Belize (Sclater and Salvin), and remains as far north as southern Lower California (Forrer) and the coasts of Louisiana (Beyer), Florida (Scott), and Georgia (Worthington).

*Migration range.*—On the way from the summer home to the winter, some individuals formerly took a course almost due east and appeared in the Maritime Provinces of Canada (Macoun) and on the coast of New England (Brown), becoming more common to the south until it would hardly have been called rare on Long Island and the New Jersey coast. At the present time it is almost unknown on the Atlantic coast north of Florida. There seem to be no winter records of the species in the West Indies, but as a rare visitant in fall migration it has been recorded from Cuba (Gundlach), Porto Rico (Gundlach), Grenada (Wells), Carriacou (Wells), and Trinidad islands (Leotaud).

A migration also takes place westward to the Pacific coast. Though the species is not known to breed within several hundred miles of the Rocky Mountains, yet it has been noted on the coast of southern Alaska (Osgood) nearly a thousand miles west of the nearest breeding grounds. This species therefore presents the unique spectacle of a bird breeding in the middle of the American continent and migrating

directly east and directly west to the ocean coasts. A wanderer was taken at Point Barrow, Alaska, August 26, 1897 (Stone), and several specimens have been taken on Hudson Bay (Preble). Individuals probably sometimes winter in California, as one was taken at Humboldt Bay, December 7, 1885 (Townsend), and at Lake Elsinore, February, 1902 (Nordhoff).

*Spring migration.*—The marbled godwit is among the earlier migrants of the shorebirds; it reaches central Illinois in early April (Griffin); Heron Lake, Minnesota, average April 12, earliest April 8, 1889 (Miller); Lincoln, Nebr., April 18, 1899 (Wolcott); Loveland, Colo., average April 27, earliest April 20, 1887 (Smith); Shoalwater Bay, Washington, April 13, 1854 (Cooper); southern Manitoba, average May 1, earliest April 29, 1901 (Wemyss); southern Saskatchewan, average May 3, earliest April 16, 1907 (Lang). Nearly all of the few spring records on the Atlantic coast are in May.

Eggs have been found at Oakland Valley, Iowa, April 20, 1878 (Rice); Winnebago, Iowa, May 6, 1871 (Kridler); Miner County, S. Dak., May 16, 1892 (Patton); Minnewaukan, N. Dak., May 22, 1892 (Rolfe); in Grant County, Minn., May 24, 1876 (Sennett); and in southern Saskatchewan, May 29, 1905 (Bent). The birds and their young were common June 8, 1820, near the mouth of the Loup Fork of the Platte, Nebraska (Say).

*Fall migration.*—The return movement begins in July, since migrants have been taken at Ugashik, Alaska, July 16, 1881 (Osgood), on the New Jersey coast late in the month (Stone), and on Pea and Bodie islands, North Carolina, July 11, 1904 (Bishop). A gunner who shot for the market near Newport, R. I., obtained only 26 of these godwits during eight seasons, the extreme dates ranging from August 6, 1873, to October 2, 1868 (Sturtevant). The latest date in Colorado is October 1, 1874 (Henshaw).

**Pacific Godwit.** *Limosa lapponica baueri* Naum.

The principal breeding range of the Pacific godwit is in northeastern Siberia, but a few individuals cross to Alaska and breed from Unalaska (Dall) to Kotzebue Sound (Grinnell). After the breeding season some wander northward to Point Barrow (Murdoch). They arrive on their breeding grounds early in May (Nelson), and are among the earliest of the waders to begin the fall migration (Nelson). The latest one seen at Point Barrow was August 18 (Murdoch), and early in September the last have left North America. The migration route passes through the Pribilof Islands, Commander Islands, Japan, China, and the Philippines. The winter home is in Australia, New Zealand, the Malay Archipelago, and many of the islands of Oceania. The Pacific godwit has been noted several times in the Hawaiian Islands (Bryan), and a straggler was once taken at La Paz, Lower California (Belding).

**Hudsonian Godwit.** *Limosa hamastica* (Linn.).

**Breeding range.**—The eggs of the Hudsonian godwit are known only from the Anderson River region of northwestern Mackenzie (MacFarlane), but since Edward A. Preble, of the Biological Survey, found the species common in July and August on the west coast of Hudson Bay, probably it breeds also not far north of this region. The breeding range is probably the Barren Grounds from the mouth of the Mackenzie to Hudson Bay.

**Winter range.**—The species winters in Argentina and Chile south to Chiloe Island (Sclater and Salvin) on the west coast and to the Strait of Magellan (Sharpe) and the Falkland Islands (Abbott). But it is rare in eastern Patagonia south of the Chubut River (Durnford), which is just opposite the southern limit on the western coast.

**Migration range.**—The migration route between the winter and summer homes is not known. In fall migration the species appears rarely on the coast of Maine (Boardman) and more commonly in Massachusetts (Howe and Allen), Rhode Island (Sturtevant), and Long Island (Dutcher). Whither the birds go when they leave Long Island is as yet unknown. On the rest of the coast of the United States the species is known only as a very rare straggler. One accidental occurrence in Cuba (Gundlach) is the only record for the Greater Antilles, and in the Lesser Antilles it is known only from the extreme eastern end on Barbados (Feilden) and Trinidad (Leotaud). It occurs on the coast of British Guiana (Quelch) and in the interior of Brazil (Pelzeln).

The species seems not to be recorded in spring anywhere on the Atlantic coast between Argentina and Long Island, with the exception of a single pair seen May 8, 1906, near Rehoboth, Del. (Pennock). The very few records on Long Island (Sharpe) and in New England (Howe and Allen) during the spring indicate that at this season it is only a straggler along the Atlantic. It passes in spring migration up the Mississippi Valley, entering the United States through Louisiana (Beyer) and Texas (Sharpe) and passing north principally along the eastern edge of the plains. The migration route between Argentina and Texas is unknown, for there is not a single spring record in the whole distance, and records at any time in the year are limited to one on the coast of Peru, November 9, 1883 (MacFarlane); one in Cuba, no date specified (Gundlach); and very doubtful records for Colombia (Burger) and Costa Rica (Zeledon).

From the above very meager data, it seems probable that the Hudsonian godwit has a migration route similar to that of the golden plover, with this important difference—that whereas the golden plover first goes eastward from its breeding grounds to the coast of Labrador and crossing the Gulf of St. Lawrence strikes out to sea from Nova Scotia, the Hudsonian godwit starts in a south-

easterly course to and down the western shore of Hudson Bay and keeps much this same course overland to the coast of New England. Thence it goes directly across the ocean to the Lesser Antilles and British Guiana, and lastly south and southwest through central Brazil to the pampas of Argentina, and to the coast of central Chile. Judging by analogy from the golden plover, the spring migration route of the Hudsonian godwit is from the pampas of northwestern Argentina directly to the coast of Texas, and almost in one flight.

This species is rare west of the Rocky Mountains. The British Museum contains specimens said to have been taken in California (Sharpe), but as this is the only record for the State it needs confirmation. A few specimens have been taken in Alaska from the Kenai Peninsula (Osgood) to the Yukon mouth (Dall and Bannister), Nulato (Sharpe), and Point Barrow (Stone) on the north, but there is no evidence that the species breeds west of the Mackenzie River. Though the Hudsonian godwit is now very rare on the New England coast, and has been since about 1886, yet previously it was so common that a gunner near Newport, R. I., records the shooting of 104 birds in the years 1867-1874 (Sturtevant).

*Spring migration.*—The species arrives on the coast of Texas in April (Sharpe) and has been recorded at Lawrence, Kans., as early as April 19, 1873 (Snow); St. Louis, Mo., April 19, 1872 (Hurter); in Grant County, Minn., April 25, 1876 (Sennett); Indian Head, Saskatchewan, May 11, 1892 (Macoun); Fort Kenai, Alaska, May 5, 1869 (Bischoff). Specimens were taken on the Falkland Islands as late as May 20, 1860 (Abbott), and in Argentina to May 24 (Sharpe). The earliest eggs taken were on June 7, 1862, at Fort Anderson (MacFarlane).

*Fall migration.*—A Biological Survey party found the Hudsonian godwit already in southward migration July 19, 1900, near York Factory, Keewatin (Preble); it was noted July 29, 1869, on the coast of Rhode Island (Sturtevant); it arrives in August in the Lesser Antilles (Leotaud); in September in Brazil (Pelzeln); and by early November has appeared at the extreme southern limit of the range (Durnford). It is probably the arrival of young birds that is recorded at Barbados (Feilden) in October, with October 7 as the average of three years and October 5, 1886, as the earliest.

The last seen near Cape Churchill, Hudson Bay, in 1900, was on August 24 (Preble); Toronto, Ontario, October 20, 1890 (Fleming); Montreal, Canada, October 11, 1895 (Wintle); Rhode Island, October 13, 1873 (Sturtevant), and Massachusetts, November 3 (Howe and Allen).

**Black-tailed Godwit.** *Limosa limosa* (Linn.).

The black-tailed godwit is confined to the Eastern Hemisphere, breeding in Iceland, and from Holland and southern Russia north to the Arctic Circle and east to western Siberia. It winters in southern

Europe and south to Abyssinia. A specimen was taken about 1830 near Godthaab, Greenland (Reinhard), and there are other less certain records of its occurrence in that country.

**Green-shank.** *Glottis nebularia* (Gunn.).

The green-shank has a very wide range in the Eastern Hemisphere. It breeds in Scotland, northern Scandinavia, and east to northern Siberia; it migrates along the coasts of both Europe and Asia, even to Japan and the Commander Islands; it winters from southern Europe and India to southern Africa and Australia.

The only record for the United States is that of three specimens taken by Audubon, May 28, 1832, on Sand Key, near Cape Sable, Florida. The species has also been recorded as an accidental visitant to Chile (Schlegel) and Buenos Aires, Argentina (Seeböhm).

**Common Red-shank.** *Totanus totanus* (Linn.).

The common red-shank is scarcely entitled to a place among North American birds. Its claim rests only on the description by Swainson and Richardson of a specimen from Hudson Bay which they said existed in the British Museum.

The common red-shank is a well-known species of Europe and Asia, where it breeds from Iceland and the Faroe Islands to southern Siberia and Turkestan and south to northern Africa. It winters in southern Europe, throughout most of Africa, and in Asia south to India and the Malay Archipelago.

**Greater Yellow-legs.** *Totanus melanoleucus* (Gmel.).

**Breeding range.**—Knowledge of the summer home of the greater yellow-legs is much lacking in definiteness. One of the best known facts is that the bird does not go far north, since it is one of the few species of the family not found on the Arctic coast, nor even to the Arctic Circle. The most northern records are: Near Fort Chimo, Ungava (Turner); accidental once at Cumberland Sound (Kumlien); on the west shore of Hudson Bay to about Cape Eskimo (Preble); Fort Simpson, Mackenzie (Ross); and to Kupreanof Island (Osgood), Lake Iliamna (Osgood), and St. Paul Island (Seale)—all in Alaska. The southern limit of the breeding range is more difficult to determine, since the mere presence of the bird in summer is not sufficient proof that it is breeding. Individuals are found during every month of the year in the West Indies, Bahamas, Florida, Texas (Sennett); and California (Grinnell), but it is not probable that the species breeds in any of these localities.

Eggs taken in British Columbia at Fort George and Fort St. James (specimens in United States National Museum) are probably the only certainly identified eggs of the species known. The bird probably breeds in British Columbia as far south as Clinton (Rhoads), and eastward across Canada, north of about the fiftieth parallel of latitude.

**Winter range.**—The greater yellow-legs winters to the southern end of the mainland of South America. To the north it occurs on both coasts and in Central America, Mexico, and the West Indies to the coast of

Georgia (Helme)—occasionally to North Carolina (Bishop)—Louisiana (Edwards), Texas (Merrill), and California. In this latter State it winters on the coast north at least to Los Angeles County (Grinnell), and in the interior to Owen Lake (Fisher).

*Spring migration.*—The advance begins in March, and the first reach Raleigh, N. C., on the average April 3, earliest March 22, 1893 (Brimley); Long Island, New York, average April 22, earliest April 17, 1896 (Worthington); eastern Massachusetts, average April 26, earliest April 22, 1893 (Browne); southern Maine, average May 9, earliest April 26, 1896 (Morrell); city of Quebec, Canada, average April 30, earliest April 18, 1903 (Dionne); Point de Monts, Quebec, average May 5, earliest April 26, 1885 (Comeau). Lake Mistassini, Quebec, May 7, 1885 (Macoun). Some other early dates along the Atlantic coast are: Patapsco Marsh, Maryland, March 26, 1875 (Kirkwood); Carlisle, Pa., March 19, 1844 (Baird); Westport Harbor, Massachusetts, March 10, 1899 (Howe and Sturtevant). The average date of arrival in central Illinois is April 6, earliest March 22, 1890 (Brown); Chicago, Ill., average April 24, earliest April 14, 1895 (Blackwelder); Oberlin, Ohio, average April 18, earliest April 12, 1905 (Jones); southern Michigan, average April 27, earliest April 24, 1897 (Hankinson); southern Ontario, average April 28, earliest April 13, 1896 (Taverner); Ottawa, Ontario, average May 9, earliest April 28, 1905 (White); Keokuk, Iowa, average April 14, earliest March 26, 1893 (Currier); Elk River, Minn., average April 21, earliest April 17, 1886 (Bailey); Aweme, Manitoba, average May 4, earliest April 30, 1902 (Criddle); Kansas City, Mo., March 9, 1903 (Bryant); Manhattan, Kans., March 11, 1883 (Lantz); Lincoln, Nebr., April 10, 1899 (Wolcott); Fort Lyon, Colo., March 28, 1886 (Thorne); Loveland, Colo., March 26, 1890 (Smith); Cheyenne, Wyo., April 11, 1888 (Bond); Great Falls, Mont., April 17, 1892 (Williams); Rathdrum, Idaho, April 20, 1901 (Danby); Fort Simpson, Mackenzie, May 23, 1860 (Ross), May 16, 1904 (Preble); Chilliwack, British Columbia, March 28, 1888 and 1889 (Brooks); Fort Kenai, Alaska, May 6, 1869 (Bischoff).

Those individuals that are to breed leave the United States by the first week in June. The species is common in Chile and Argentina through the winter and to early April, when most leave for the north, but some remain the whole summer in Argentina (Holland), 6,000 miles south of the breeding range.

Eggs have been taken at Fort St. James, British Columbia, May 31, 1889 (MacFarlane), and at Fort George, British Columbia, May 20, 1890 (specimens in United States National Museum). The earliest downy young noted in 1901 in the Caribou district, British Columbia, were seen on June 15 (Brooks).

*Fall migration.*—Hardly six weeks elapse between the passage of the last northward-bound migrants on Long Island, New York,

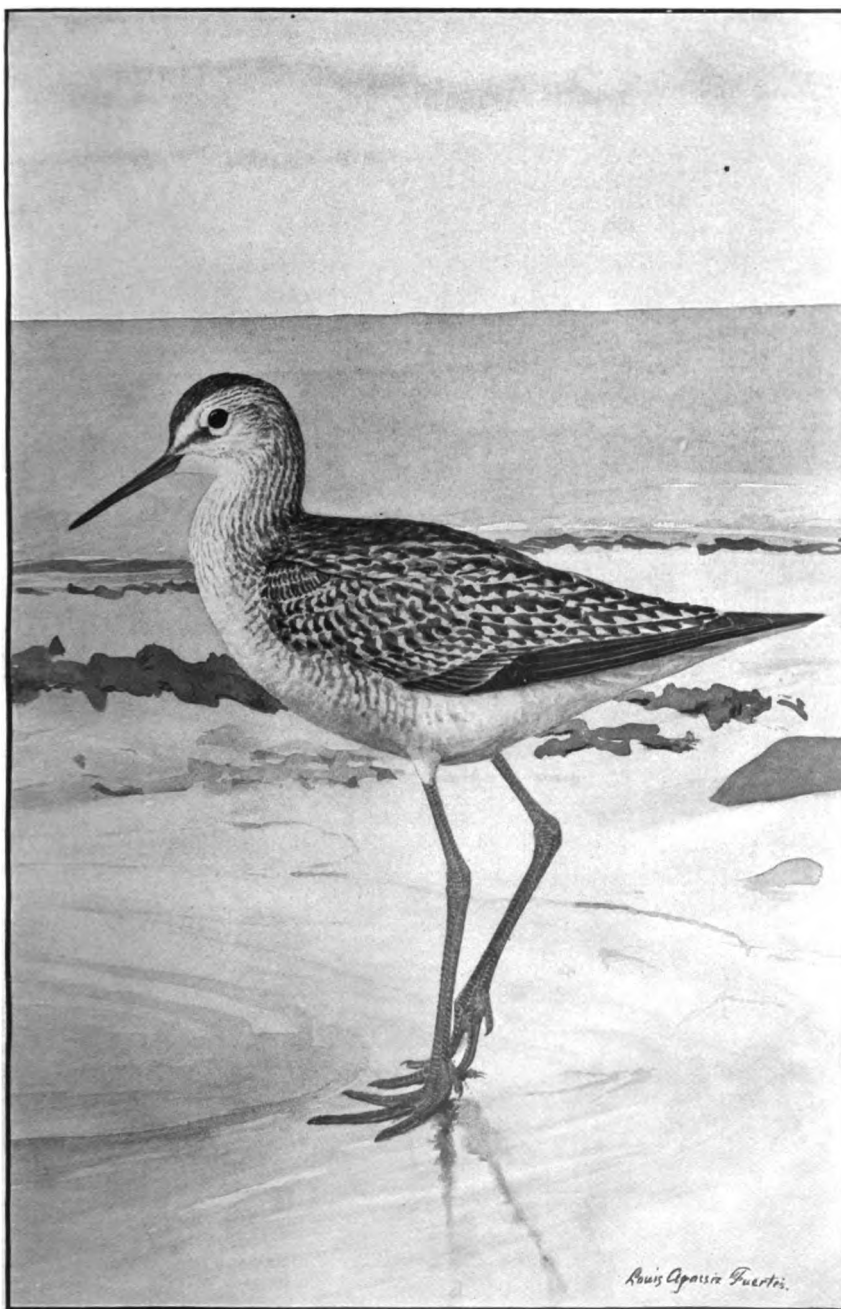
and the appearance of the first fall migrants; on the average the last in spring pass May 28, latest June 14, 1901 (Scott), while the average date of fall arrival is July 19, earliest July 10, 1887 (Scott). The larger flights there do not come until August, and the species is most common in September and October. Formerly this was one of the common species of shorebirds and one much sought by gunners. A hunter near Newport, R. I., shot 1,362 greater yellow-legs in the eight seasons 1867-1874, on dates ranging from July 20, 1870, to November 4, 1870; his highest score, 419 birds, was in 1873, from August 19 to October 19. Dates of fall arrival are: Granville, Wash., July 7, 1897 (Young); Utah Lake, Utah, July 26, 1872 (Henshaw); Aweme, Manitoba, average July 29, earliest July 27, 1901 (Criddle); Lipscomb, Tex., one June 29, common July 8, 1903 (Howell); Pacheco, Chihuahua, July 30, 1905 (Brown); Toronto, Ontario, July 28, 1891 (Nash); Cullingham Cove, Ungava, July 31, 1891 (Norton); Anticosti Island, July 8, 1881 (Brewster); Erie, Pa., July 28, 1896 (Todd); Washington, D. C., July 24, 1890 (Richmond); Bahama Islands, July 6, 1904 (Allen); Barbados, West Indies, July 25, 1886 (Manning); Bonaire Island, off the coast of Venezuela, July 21, 1892 (Hartert).

Dates of the last seen are: Near Fort Churchill, Keewatin, August 8, 1900 (Preble); Hayes Run, Keewatin, August 30, 1900 (Preble); Oxford House, Keewatin, September 10, 1900 (Preble); Cumberland Sound, September 14, 1877 (Kumlien); near Fort Chimo, Ungava, September 19, 1882 (Turner); Portage la Prairie, Manitoba, October 21, 1884 (Nash); Chilliwack, British Columbia, November 17, 1888, (Brooks), November 21, 1889 (Brooks); Long Island, New York, average November 5, latest November 20, 1901 (Scott). The late dates of departure explain the name winter yellow-legs for this species.

**Yellow-legs.** *Totanus flavipes* (Gmel.).

**Breeding range.**—The principal summer home of the yellow-legs is the Barren Grounds and neighboring regions to the southward. The species ranges north to southern Ungava (Selwyn), central Keewatin (Preble), and nearly to the Arctic coast in northern Mackenzie (MacFarlane). It breeds north to Kotzebue Sound (Townsend) and Fort Yukon (Dall and Bannister), but apparently does not occur on the northern coast of Alaska. The southern limit of the breeding range is imperfectly known; the species breeds in Yukon at least south to Lake Marsh (Bishop), and in the interior probably to southern Alberta (Macoun), southern Saskatchewan (Macoun), and northern Quebec (Macoun).

**Winter range.**—The yellow-legs passes south in winter to the Strait of Magellan (Gay) and occurs at this season quite generally over the southern half of South America, and even in the mountains up to 10,000 feet (Sclater). Winter records north of this region are few, and probably only a comparatively small number regularly winter



YELLOW-LEGS (TOTANUS FLAVIPES).



north of South America. A few winter in southern Mexico, as far north as Cozumel Island (Sharpe) and La Barca, Jalisco (Goldman); a few are noted occasionally in Louisiana (Beyer) and in Florida in winter (Pillsbury), and the species occurs rarely in the Bahamas at this season (Bonhote).

*Migration range.*—The yellow-legs is common on the Atlantic coast in fall and many pass through the Lesser Antilles. In this latter region it is practically unknown in spring, and it is rare in spring migration on the Atlantic coast north of Long Island, New York. These facts would seem to indicate that some yellow-legs pursue different migration routes in fall and spring. The species is a common migrant in the Mississippi Valley both spring and fall, and hence probably most of those that go south through the Lesser Antilles return in spring to their breeding grounds by way of the Mississippi Valley.

The species is not common on the Atlantic coast north of the Gulf of St. Lawrence, though one was taken October 8, 1882, near Fort Chimo, Ungava (Turner), and two have been taken in southern Greenland (Winge).

The yellow-legs is rarely seen west of the Rocky Mountains, but a few occur along the coast from northern Alaska (Grinnell) to southern Lower California (Brewster). One was taken June 11, 1890, on St. Paul Island (Palmer).

*Spring migration.*—The following dates show the usual time at which the yellow-legs arrives in its northward migration: Northern Texas, average March 26, earliest March 22, 1899 (Mayer); central Missouri, average April 14, earliest April 9, 1903 (Bryant); Keokuk, Iowa, average April 16, earliest March 11, 1894 (Currier); central Nebraska, average April 28, earliest March 27, 1900 (Wolcott); Chicago, Ill., average April 23, earliest April 15, 1899 (Gault); Oberlin, Ohio, average April 28, earliest April 23, 1904 (Jones); Raleigh, N. C., average April 1, earliest March 25, 1893 (Brimley). The following are dates of occurrence somewhat earlier than the average: Cumberland, Ga., March 12, 1902 (Helme); Washington, D. C., March 12, 1906 (Green); Havre de Grace, Md., March 15, 1895 (Kirkwood); near Newport, R. I., April 28, 1902 (King); Godbout, Quebec, May 5, 1888 (Comeau); San Antonio, Tex., March 20, 1903 (Norton); Bay St. Louis, Miss., March 13, 1902 (Allison); Sioux City, Iowa, March 11, 1864 (Feilner); southern Ohio, March 18, 1901 (Henninger); Lanesboro, Minn., April 7, 1890 (Hvoslef); Fort Lyon, Colo., March 30, 1886 (Thorne); Indian Head, Saskatchewan, April 25, 1892 (Macoun); Edmonton, Alberta, May 1, 1901 (Preble); Fort Reliance, Yukon, May 3 (Nelson); Fort Resolution, Mackenzie, May 5, 1860 (Kennicott); Willow River, Mackenzie, May 9, 1904 (Mills and Jones); Fort Reliance, Mackenzie, May 13, 1834 (Back); Fort

Franklin, Mackenzie, May 16, 1826 (Richardson); Fort Anderson, Mackenzie, May 27, 1865 (MacFarlane). The yellow-legs is thus about the earliest shorebird to reach high northern latitudes.

Eggs were taken at Fort Resolution June 1, 1860 (Kennicott); near Fort Anderson, June 15, 1863, June 20, 1864, and June 16, 1865 (MacFarlane); and downy young July 1, 1899, at Lake Marsh, Yukon (Bishop).

*Fall migration.*—Like so many other waders, the yellow-legs begins its southward journey early in July, so early indeed that migrants have appeared on the Bermudas by July 13 (Reid). Other dates of fall arrival are: Chilliwack, British Columbia, July 25, 1889 (Brooks); Fort Lyon, Colo., July 23, 1884 (Thorne); Aweme, Manitoba, July 26, 1901 (Criddle); Toronto, Ontario, July 18, 1891 (Nash); near Chicago, Ill., July 3, 1893 (Dunn), abundant by July 25 (Parker); Long Island, New York, July 14, 1887 (Scott), July 9, 1905 (Latham); Long Beach, New Jersey, July 9, 1877 (Scott); James Island, Florida, July 20, 1901 (Williams); Key West, Fla., July 16, 1888 (Scott); Inagua, Bahamas, July 28, 1891 (Cory); Jamaica, August 2, 1891 (Field); the average date of arrival in the Lesser Antilles is about July 25, earliest July 4, 1888 (Feilden); Santo Domingo, Venezuela, July 24, 1903 (Briceno); Fortin Page, Argentina, September 13, 1890 (Kerr). The yellow-legs is one of the earliest birds to migrate in fall, and the greater number have left the breeding grounds by the latter part of August. A few linger quite late, as shown by the following dates of the last seen: Near Fort Chimo, Ungava, October 8, 1882 (Turner); Montreal, Canada, October 7, 1898 (Wintle); Scotch Lake, New Brunswick, October 28, 1901 (Moore); Ottawa, Ontario, October 18, 1901 (White); Lanesboro, Minn., October 11, 1888 (Hvoslef); Oberlin, Ohio, October 18, 1899 (Jones); Long Island, New York, October 18, 1905 (Latham); Erie, Pa., October 14, 1893 (Todd); Lincoln, Nebr., November 17, 1900 (Wolcott).

**Solitary Sandpiper.** *Helodromas solitarius* (Wils.).

*Breeding range.*—Few facts are known concerning the breeding range of this species. It has been seen in summer over a great extent of country; the young only a few days old have been noted in widely separated localities, but the nest and eggs are almost unknown. The species as a whole, including the eastern and western forms, ranges north in summer to Newfoundland (Reeks); Fort Chimo, northern Ungava (Turner); Great Bear Lake, Mackenzie (Richardson); and to Kowak River, in northwestern Alaska (Grinnell). The southern limit of the breeding range is entirely undetermined. The birds stay in summer as far south as Pennsylvania (Todd), Illinois (Ridgway), Nebraska (Cary), Colorado (Cooke), and Washington (Dawson).

*Winter range.*—There seem to be no winter records whatever of the western form of the solitary sandpiper. There is every reason

for believing that it winters in South America, and has not been distinguished there from the eastern form. The following statement of the winter range doubtless includes both forms, but it is not safe to conclude that the eastern form goes to eastern South America and the western form to the Pacific coast. It is known that the eastern form migrates to the Pacific coast of Mexico, and it is probable that thence southward the two forms commingle both in migration and during the winter. The species as a whole ranges south in winter to Buenos Aires, Argentina (Barrows); to Caiza, in south-eastern Bolivia (Salvadori); and to Chorillos, central Peru (Taczanowski). It occurs regularly also at this season in northern South America to Guiana (Quelch), Venezuela (Berlepsch and Hartert), and Colombia (Salvin and Godman). North of South America it is not common anywhere in winter, and it may not winter at any of the following places, but it has been noted as late as December in Porto Rico (Bowditch), Costa Rica (Todd), Yucatan (Sharpe), Veracruz (Sharpe), and northern Lower California (Stephens).

*Migration range.*—A specimen was taken in Greenland August 1, 1878, at Kangek, latitude  $64^{\circ}$  (Hagerup); and one of the eastern form was taken October 28, at San José del Cabo, Lower California (Brewster).

*Spring migration.*—The following records include both the eastern and western forms: The species arrives in the southern United States in March; Tallahassee, Fla., March 25, 1901 (Williams); Coosada, Ala., March 28, 1878 (Brown); Bay St. Louis, Miss., March 17, 1902 (Allison); New Orleans, La., average March 16, earliest March 5, 1900 (Allison); Boerne, Tex., March 25, 1880 (Brown); while some of the earliest records in California are at Los Angeles, April 21, 1897 (Grinnell), and Gridley, April 23, 1891 (Belding). Further progress northward is decidedly slow, as shown by the following dates of arrival: Raleigh, N. C., average April 24, earliest April 4, 1889 (Brimley); near Asheville, N. C., average April 22, earliest April 9, 1890 (Cairns); Washington, D. C., average April 28, earliest April 25, 1900 (Preble); Englewood, N. J., average April 30, earliest April 28, 1900 (Lemmon); near New York City, average May 4, earliest April 30, 1899 (Thayer); Renovo, Pa., average May 4, earliest May 1, 1897 (Pierce); eastern Massachusetts, average May 6, earliest May 2, 1891 (Long); southwestern Maine, average May 11, earliest April 28, 1903 (Swain); Petitcodiac, New Brunswick, May 14, 1887 (Willis); Pictou, Nova Scotia, May 7, 1894 (Hickman); Lake Mistassini, Quebec, May 23, 1885 (Macoun); central Iowa, average April 25, earliest April 10, 1899 (Savage); Chicago, Ill., average April 23, earliest April 7, 1887 (Coale); Bloomington, Ind., average May 2, earliest April 23, 1903 (McAtee); Oberlin, Ohio, average April 29, earliest April 18, 1909 (Jones); Ottawa, Ontario, average May 11,

earliest May 2, 1896 (White); southern Wisconsin, average May 6, earliest April 25, 1897 (Russel); Lanesboro, Minn., average May 6, earliest April 24, 1888 (Hvoslef); near San Antonio, Tex., average April 17, earliest March 25, 1880 (Brown); central Kansas, average May 2, earliest April 23, 1885 (Kellogg); Harrisburg, N. Dak., average May 5, earliest May 3, 1904 (Eastgate); Aweme, Manitoba, average May 13, earliest May 9, 1906 (Criddle); Colorado Springs, Colo., May 1, 1882 (Allen and Brewster); Terry, Mont., May 7, 1903, May 9, 1904 (Cameron); Athabaska Landing, Alberta, May 5, 1901 (Preble); Sandy Creek, Alberta, May 14, 1903 (Preble); Fort Providence, Mackenzie, May 14, 1905 (Jones); Fort Simpson, Mackenzie, May 10, 1904 (Preble); Great Bear Lake, May 14, 1826 (Richardson); Fort Steilacoom, Wash., May 6, 1856 (Suckley); Chilliwack, British Columbia, May 7, 1888 (Brooks); Nulato, Alaska, May 15, 1867, May 18, 1868 (Dall); Kowak River, Alaska, May 18, 1899 (Grinnell).

One of the parties of the Biological Survey took downy young June 23, 1903, at Charlie Creek, Alaska (Osgood); eggs are reported from central Alberta, June 24, 1908, June 15, 1908, June 1 and June 9, 1909 (Thayer and Arnold), and young in the nest were found June 19, 1908, at Stony Plain, Alberta (Stansell).

*Fall migration.*—Early dates in the fall south of the breeding range are: Washington, D. C., average July 21, earliest July 15, 1899 (Howell); Raleigh, N. C., average July 25, earliest July 14, 1894 (Brimley); Key West, Fla., July 28, 1888 (Scott); New Orleans, La., July 20, 1899 (Kopman); Kerrville, Tex., July 20, 1903 (Lacey); Camp Apache, Ariz., July 29, 1873 (Henshaw); Bermudas, July 19, 1874 (Reid); St. Croix, West Indies, July 26, 1857 (Newton); San José del Cabo, Lower California, August 25, 1887 (Brewster); near Buenos Aires, Argentina, August 20, 1880 (Barrows).

Dates of the last seen are: Chilliwack, British Columbia, September 13, 1889 (Brooks); Aweme, Manitoba, September 18, 1904 (Criddle); Chicago, Ill., October 6, 1899 (Gault); Lincoln, Nebr., October 20, 1900 (Wolcott); Ottawa, Ontario, October 31, 1906 (White); Hillsboro, Iowa, October 20, 1899 (Savage); Delavan, Wis., October 20, 1892 (Hollister); Lexington, Ky., October 23, 1904 (Dean); Pictou, Nova Scotia, October 8, 1894 (Hickman); Scotch Lake, New Brunswick, October 5, 1901 (Moore); southwestern Maine, October 21, 1904 (Norton); Renovo, Pa., October 14, 1897 (Pierce); Chesapeake Beach, Md., November 2, 1906 (Riley); Beaver, Pa., November 28, 1901 (Todd).

**Western Solitary Sandpiper.** *Helodromas solitarius cinnamomeus* (Brewst.).

The western solitary sandpiper occurs in western North America and ranges at least as far east as Great Slave Lake (Preble), Athabaska Lake (Preble), the eastern foothills of the Rocky Mountains

in Colorado (Henshaw), and to central Texas (Gaut). It migrates throughout western Mexico and east to Veracruz (Sartorius) and Tehuantepec (Sumichrast). As already stated, the winter range has not yet been determined.

**Green Sandpiper.** *Helodromas ocropus* (Linn.).

The green sandpiper, an Old World species, is widely distributed breeding from the Pyrenees to southern Siberia, principally in the mountains. It winters from southern Europe and Japan, throughout Africa, and to Ceylon. It is supposed to have occurred at Halifax, Nova Scotia (Harting), and in the Hudson Bay Company's territory (Nuttall), but the evidence is not conclusive.

**Wood Sandpiper.** *Rhyacophilus glareola* (Linn.).

The wood sandpiper is one of the best known of the Old World sandpipers. It breeds over most of Europe and Asia from the valley of the Danube and northern China to the Arctic coast. It winters from the Mediterranean and India to southern Africa and the Malay Archipelago. The only record of the species in North America is that of a single specimen taken May 27, 1894, on Sanak Island, Alaska (Littlejohn).

**Willet.** *Catoptrophorus semipalmatus* (Gmel.).

**Breeding range.**—The breeding range of the willet on the Atlantic coast has become much restricted of late years. Formerly it bred north, commonly to New Jersey (Giraud), and rarely to Sable Island (eggs in United States National Museum), Yarmouth (Bryant), and Halifax (Brewer), Nova Scotia. It still breeds rather commonly on the islands off the coast of Virginia (Dutcher), and a few may breed in extreme southern New Jersey, but probably at present no willets breed between there and Nova Scotia, where in 1903 it was reported abundant at Barrington (Trotter). It breeds along the south Atlantic coast to Florida (Scott), and throughout the Bahamas (Bonhote.)

**Winter range.**—On the Pacific coast it migrates in winter to Santa Lucia, southern Peru (Taczanowski), and on the Atlantic coast to the Amazon River (Pelzeln). It occurs also in winter in northern South America (Quelch), the Lesser and the Greater Antilles, the Bahamas (Bonhote), Florida (Worthington), and casually in South Carolina (Hoxie).

**Spring migration.**—The willet starts north in March. Some dates of spring arrival are: Hog Island, Virginia, average April 12, earliest April 7, 1888 (Doughty); southern New Jersey, average April 19, earliest April 6, 1877 (Scott); Erie, Pa., April 24, 1902 (Todd). The species has been recorded in migration to Newfoundland (Reeks), but it is not known to breed on that island.

Eggs have been taken in the Bahamas from May 15 (Cory) to July 6 (Allen); Sapelo Island, Georgia, April 22, 1888 (specimens in

United States National Museum); Beaufort, N. C., May 8 (specimens in United States National Museum); Cobbs Island, Virginia, May 25, 1875 (Baily); Warner House, N. J., May 19, 1884 (Bellows); Madison, Conn., June 5, 1873 (Merriam); and on Sable Island in June (specimens in United States National Museum).

*Fall migration.*—A gunner who shot for the market near Newport, R. I., obtained 106 willets during eight seasons, 1867–1874, on dates ranging from July 11, 1871, to September 19, 1869 (Sturtevant). One bird was seen July 2, 1902, at Sakonnet, R. I. (King). The average date of arrival of late years on Long Island, New York, has been August 13, earliest August 4, 1901 (Scott). The last was seen at Plymouth, Mass., October 4, 1852 (Browne); Long Island, New York, September 24, 1905 (Latham); southern New Jersey, average September 9, latest October 17, 1885 (Crane); Hog Island, Virginia, November 1, 1886, and October 27, 1887 (Doughty).

**Western Willet.** *Catoptrophorus semipalmatus inornatus* (Brewst.).

*Breeding range.*—The western willet breeds on the coasts of Texas (Merrill) and Louisiana (Beyer) and from northern Iowa (Berry), southern South Dakota (Cheney), and northern California (Beckwith; Christie), north to the southern portions of Manitoba (Thompson), Saskatchewan (Ferry), Alberta (Macoun), and to central Oregon (Bendire).

*Winter range.*—The western willet winters on the coasts of Louisiana (Beyer) and Texas (Sennett) and on the coast of California north to Humboldt Bay (Townsend). In winter it ranges south into Mexico (Nelson) and probably to southern Guatemala (Salvin). It also passes eastward and winters on the Gulf coast of Florida (Scott).

*Spring migration.*—Dates of spring arrival are: Stotesbury, Mo., April 8, 1894 (Surber); Keokuk, Iowa, April 30, 1892 (Currier); Lanesboro, Minn., April 26, 1879 (Hvoslef); central Kansas, average April 30, earliest April 28, 1883 (Lantz); northern Nebraska, earliest May 5, 1893 (Bates); northern North Dakota, average May 3, earliest May 1, 1901 (Eastgate); Indian Head, Saskatchewan, May 6, 1892 (Macoun); northern Colorado, average May 1, earliest April 27, 1887 (Smith); Cheyenne, Wyo., average May 4, earliest April 30, 1888 (Bond); Salt Lake City, Utah, April 28, 1897 (Young); Lewiston, Mont., May 2, 1903 (Silloway); Red Deer, Alberta, May 12, 1892 (Farley); Halleck, Nev., May 5, 1871 (specimen in United States National Museum); Fort Klamath, Oreg., April 22, 1887 (Merrill).

Eggs have been taken at Corpus Christi, Tex., May 17, 1882 (Goss); near Turtle Mountain, Manitoba, May 23, 1883 (Thompson); Oneida County, Idaho, May 21, 1879 (Anderson); near Beckwith, Calif., May 28, 1891 (Christie); Camp Harney, Oreg., May 8, 1878 (Bendire); southern Saskatchewan, June 14, 1906 (Bent). Thus the nesting season is about the same throughout the whole breeding range.

*Fall migration.*—In fall the western willet wanders eastward far beyond the breeding range, even to the Atlantic coast, as shown by the following records: Chicago, Ill., September 2, 1906 (Armstrong and Lawson); Miller, Ind., August 14, 1897 (Woodruff); Oberlin, Ohio, September 17, 1906 (Jones); Toronto, Ontario, July 20, 1898 (Fleming); Stony Creek, Conn., August 15, 1897 (Bishop); Keokuk, Iowa, October 27, 1896 (Currier). A wanderer far north of the breeding range was taken at Victoria, British Columbia, August 18, 1898 (Fannin).

**Wandering Tattler.** *Heteractitis incanus* (Gmel.).

The first information of the breeding range of the wandering tattler was obtained in 1904 by one of the parties of the Biological Survey. A downy young was shot September 5 on Macmillan River in east central Yukon (Osgood). July 28, 1906, a pair were seen by Charles Sheldon near Mount McKinley, south central Alaska, under conditions that left no doubt that they were breeding in the immediate vicinity. It is not probable that the species breeds anywhere south of Alaska, and yet it occurs in the Hawaiian Islands every month of the year (Henshaw); on the coast of California every month from March to October (Bryant), and has been taken July 2, 1900, on the island of Guam, and July 17, 1904, on the Philippine Islands (specimens in the United States National Museum). The species ranges north to Nulato, Alaska (Dall), where it is said by the natives to breed, and occurs about as far north on the Asiatic side of Bering Sea to Plover Bay (Bean), where it was taken in fall migration.

The wandering tattler winters in lower California, the Galapagos (Sharpe), the Hawaiian Islands (Henshaw), and throughout Oceania to the New Hebrides. In migration it occurs on the Commander Islands, along the whole western coast of North America from Mexico to Alaska, and has occurred inland, accidentally at Crater Lake, Oreg. (Bendire), and on the eastern shore of James Bay (Bell).

Spring migration begins in March, bringing the birds to the coast of California (Grinnell) by the latter part of the month. The Aleutian Islands are reached the middle of May (Nelson), and the most northern part of the range by the latter part of the month (Dall).

On the coast of central California, nearly 2,000 miles south of the breeding grounds, the first fall migrants appear with great regularity within a few days of the middle of July, and are common a few days later (Loomis). At about the same time the birds return from the interior of Alaska to the coast, and are common around Bering Sea for the next two months (Nelson). The last leave the northern part of the range about the middle of September (Nelson) and desert the Aleutians a month later (Bishop).

**Ruff.** *Machetes pugnax* (Linn.).

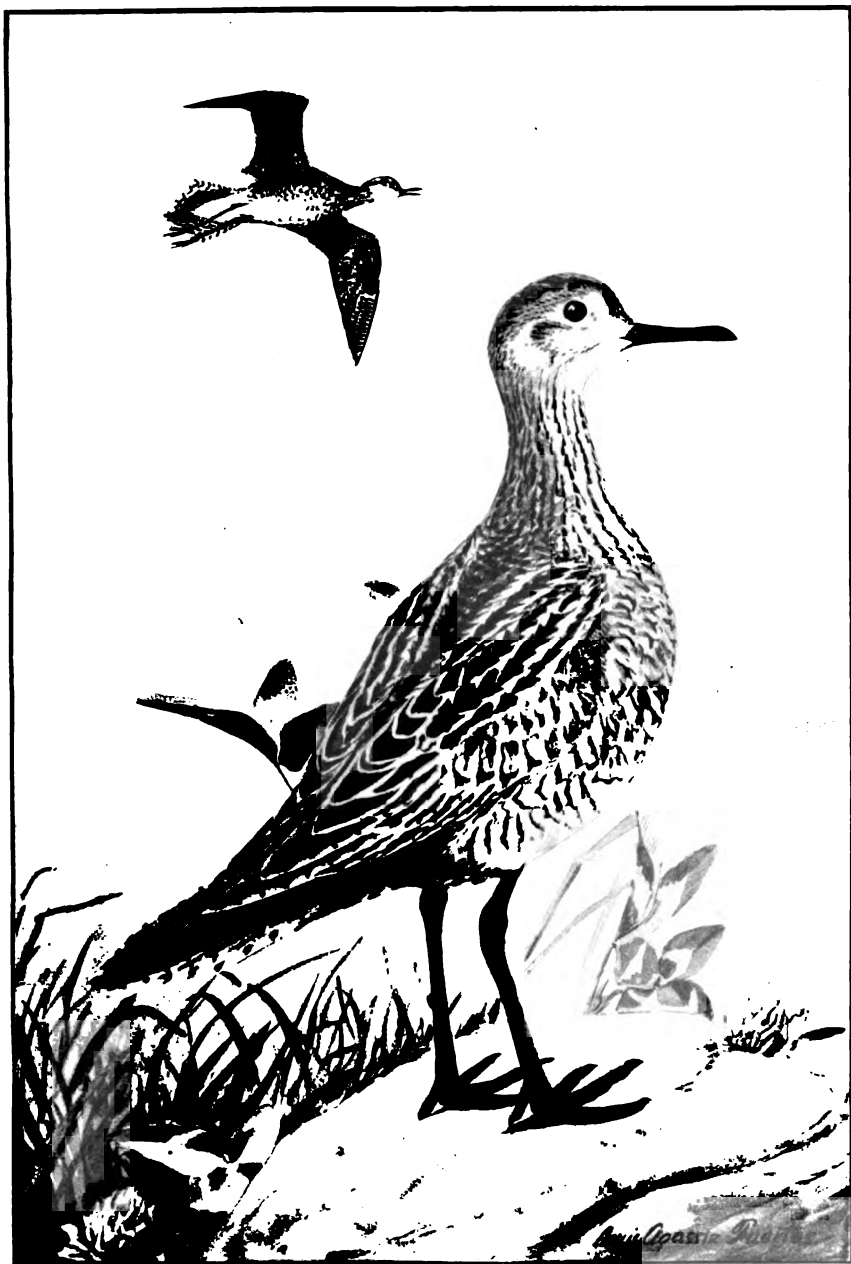
Though an Old World species, the ruff has been taken many times in the Western Hemisphere at widely separated localities as follows: One at Nanortalik, on the southwest coast of Greenland, (Fenckers); Toronto, Ontario, spring of 1882 (Seton); English Lake, Ind., April 12, 1905 (Deane); a specimen in the Ohio State University collection bears the label, "Northern Canada, April 28, 1877" (Dawson); Licking Reservoir, Ohio, November 10, 1872 (Wheaton); Columbus, Ohio, April 28, 1878 (Jones); Grand Manan, New Brunswick, no date (Boardman); Cole Harbor, near Halifax, Nova Scotia, May 27, 1892 (Brewster); Upton, Me., September 8, 1874 (Brewster); Scarborough, Me., April 10, 1870 (Smith); Camden, Me., September 14, 1900 (Thayer); Seabrook, N. H., September 24, 1907 (Hardy); Newburyport, Mass., May 20, 1871 (Brewster); Chatham, Mass., September 12, 1880 (Grinnell); Nantucket, Mass., July, 1901 (Palmer); near Sakonnet Point, Rhode Island, July 30, 1900 (Hathaway); Point Judith, Rhode Island, August 31, 1903 (King); Long Island, New York, one in fall, 1845 (Lawrence), one in October, 1851 (Lawrence), one in May 18, 1868 (Chapman); another specimen seems to have been taken on Long Island, but the date is not recorded (DeKay); Barnegat, N. J., no date (Chapman); Four Mile Run, Va., September 3, 1894 (Palmer); Raleigh, N. C., May 6, 1892 (Brimley); Barbados Island, one before 1848 (Schomburgk), and one in 1878 (Feilden); one in "Spanish America," which probably means near the headwaters of the Rio Negro in northern South America (Pelzeln).

It is thus seen that the ruff has been taken in this hemisphere at least 27 times. Seven of the specimens have no date recorded; 9 were secured in the spring between April 10 and May 27; the other 11 were taken in the fall from July 30 to November 10. As would be expected, most of the specimens are from near the Atlantic coast; only 5 occurred in the interior, the westernmost being the one at English Lake, Indiana.

The breeding range of the ruff is from Great Britain to central Siberia and north to the Arctic coast. The bird winters in Burma, India, and to the southern part of Africa. It has wandered east in Asia to Japan and the Commander Islands, but has not yet been detected on the western coast of America.

**Upland Plover.** *Bartramia longicauda* (Bechst.).

**Breeding range.**—The upland or field plover, sometimes called the Bartramian sandpiper, is one of the few shorebirds that nest commonly in the Mississippi Valley. Early in the settlement of this region, much more than half the upland plovers probably nested within the boundaries of the United States. The center of abundance during the breeding season was the prairie region from Kansas to Manitoba.



UPLAND PLOVER (*BARTRAMIA LONGICAUDA*).



The numbers were not greatly diminished so long as this region was used for stock purposes, but recently the birds have rapidly decreased. At the present time the species breeds south to southern Oregon (Merrill); northern Utah (Ridgway); northern Colorado (Rockwell), central Oklahoma (Merrill), southern Missouri (Prior), southern Indiana (Butler), northern Virginia (Grinnan) and central Maryland (Miller). The summer range extends north to southern Maine (Norton), southern Ontario (Renfrew; Clarke), and southern Michigan (Wood). Then it bends far to the northward through central Wisconsin (Kumlien and Hollister) to central Keewatin (Cape Eskimo; Preble), southern Mackenzie (Fort Smith; Preble), northern Yukon (M'Dougall), and to the Kowak River in northwestern Alaska (Townsend). Stragglers are not uncommon in the Maritime Provinces and have occurred in Newfoundland (Reeks) and to Godbout, Quebec (Merriam). The species is not common east of Michigan nor west of the Rocky Mountains.

*Winter range.*—The principal winter home is in Argentina (Sclater and Hudson) and probably no upland plovers occur at this season north of the pampas of South America.

*Migration range.*—In fall this species passes through the Greater and the Lesser Antilles (Feilden), but in the Bahamas (Cory), Jamaica (March), and Porto Rico (Gundlach), it is so much rarer than farther east as to indicate that some individuals reach the Lesser Antilles by direct flight across the ocean. It migrates also through the Gulf States and west to Sulphur Spring, Ariz. (Henshaw), western Mexico (Durango; Nelson), and locally in Central America and the northern parts of South America.

There seem to be no spring records of migration in the West Indies east of Cuba, indicating that the individuals that go south through the Lesser Antilles return by way of Central America. Nor in spring migration is the species recorded west of central Mexico or west of the Rocky Mountains south of Utah. The only record for California is the single bird taken by Vernon Bailey of the Biological Survey at Tule Lake, August 8, 1896.

*Spring migration.*—The upland plover arrives in Louisiana on the average earlier than in either Florida or Texas. This would seem to prove that it reaches Louisiana by direct flight across the gulf. The average date of arrival in southern Louisiana is March 14, while the date of arrival at the same latitude in Texas is March 28, and in Florida is early April. The earliest dates are: Bonham, Tex., March 5, 1887 (Peters); New Orleans, La., March 9, 1895 (Beyer); and Tallahassee, Fla., March 25, 1901 (Williams). Other dates of arrival on the Atlantic slope are: Raleigh, N. C., average April 7, earliest March 28, 1896 (Brimley); Washington, D. C., March 21, 1896 (Richmond); Holland Patent, N. Y., average April 20, earliest

April 14, 1896 (Williams); central Connecticut, average April 29, earliest April 16, 1896 (Jennings); southern New Hampshire, average April 30, earliest April 22, 1900 (Dearborn); Plymouth, Me., average May 3, earliest April 25, 1878 (Thorne); central Vermont, average May 5, earliest April 30, 1887 (Goodwin); Godbout, Quebec, May 7, 1885 (Merriam).

Migration in the Mississippi Valley begins earlier than on the Atlantic coast and is earlier for corresponding latitudes all the way north to the Canadian boundary, as shown by the following dates of arrival: Odin, Ill., average April 4, earliest March 30, 1895 (Vandercock); Tampico, Ill., average April 11, earliest April 9, 1890 (Brown); Chicago, Ill., average April 16, earliest April 10, 1896 (Gault); Oberlin, Ohio, average April 14, earliest March 22, 1904 (Jones); southern Michigan, average April 20, earliest April 8, 1895 (Alexander); central Iowa, average April 15, earliest April 3, 1893 (Ross); southern Wisconsin, average April 18, earliest April 10, 1853 (Stiles); Heron Lake, Minnesota, average April 24, earliest April 20, 1890 (Miller); Manhattan, Kans., average April 14, earliest April 4, 1882 (Lantz); Onaga, Kans., average April 14, earliest April 7, 1893 (Crevecœur); southern Nebraska, average April 17, earliest April 6, 1890 (Wilson); northern Nebraska, average April 18, earliest April 7, 1903 (Colt); central South Dakota, average April 23, earliest April 19, 1886 (Cheney); Argusville, N. Dak., average May 5, earliest April 26, 1894 (Edwards); Larimore, N. Dak., average May 5, earliest April 26, 1888 (Eastgate); Aweme, Manitoba, average May 3, earliest April 26, 1899 (Criddle); Lake Como, Wyoming, May 5, 1879 (Williston); Rathdrum, Idaho, average May 12, earliest April 27, 1901 (Danby); Columbia Falls, Mont., average May 12, earliest April 27, 1894 (Williams); Edmonton, Alberta, May 12, 1903 (Preble); Red Deer, Alberta, May 13, 1892, May 11, 1893 (Farley); 150-mile House, British Columbia, May 16, 1901 (Brooks).

In the winter home in Argentina the northern movement begins in February, and most birds are gone by the end of March; a few stragglers remain to April (Sclater and Hudson). The species passes through Peru in March and April (Sclater and Salvin); the last was seen at Piedra Blanca, Bolivia, April 23 (Allen); at Tonantins, Brazil, May 7, 1884 (Berlepsch); Cabanas, Cuba, May 22, 1900 (Palmer and Riley); Teopisca, Chiapas, May 7, 1904 (Goldman); and New Orleans, La., May 19, 1894 (Allison).

Eggs have been secured at Lawrenceville, N. J., May 18, 1889 (Phillips); Holland Patent, N. Y., May 21, 1886 (Williams); Marthas Vineyard, Mass., May 25, 1900 (Durfee); Cornwall, Vt., May 26, 1889 (Parkhill); Philo, Ill., May 4, 1900 (Hess); Winnebago, Ill., May 10, 1864 (Tolman); near Dubuque, Iowa, May 14, 1865 (Blackburn); Beatrice, Nebr., May 16, 1895 (Pearse); near Bryant, S. Dak., May 26, 1895 (Lee); Lewistown, Mont., May 25, 1904 (Silloway); Car-

berry, Manitoba, May 30, 1886 (Seton); southwestern Saskatchewan, May 29, 1905 (Bent).

*Fall migration.*—Birds were observed at Lipscomb, Tex., July 10, 1903 (Howell), and as they do not breed in that locality, these were southbound migrants. Observers easily detect the call notes of the upland plover as it passes overhead in the darkness, and these calls are usually the first signs of the fall migration. The earliest notes in 1895 at Baltimore, Md., were heard July 3, 1895 (Kirkwood); at Washington, D. C., the first calls have been heard usually between July 10 and July 16, while in 1896 the birds were seen July 7 (Richmond). The average date of arrival in southern Louisiana is July 23, earliest July 9, 1895 (Blakemore); Gainesville, Tex., July 13, 1885 (Ragsdale); Fort Lyon, Colo., July 12, 1886 (Thorne); Sulphur Springs, Ariz., August 18, 1874 (Henshaw); Chapala, Jalisco, August 27 (Richardson); San Jose, Costa Rica, September 5, 1890 (Cherrie); Barbados, West Indies, August 12, 1886 (Manning); Cienega, Colombia, September 15, 1898 (Allen). In September they first appear on their passage through Peru (Sclater and Salvin), and are noted as arriving at their winter home in Argentina (Sclater and Hudson). The last one was seen September 6, 1903, at Big Sandy, Mont. (Coubeaux); at Fort Lyon, Colo., September 2, 1886 (Thorne); near Cape Eskimo, Keewatin, August 13, 1900 (Preble); Aweme, Manitoba, average September 6, latest September 28, 1897 (Criddle); Onaga, Kans., average September 14, latest October 15, 1896 (Crevecoeur); southern Iowa, average September 20, latest September 30, 1896 (Savage); Livonia, Mich., September 18, 1891 (Alexander); Detroit, Mich., October 20, 1902 (Swales); Chicago, Ill., average September 6, latest September 22, 1906 (Armstrong and Lawson); Lexington, Ky., October 11, 1903 (Dean); New Orleans, La., October 7, 1896 (Kopman); North River, Prince Edward Island, August 25, 1887 (Bain); Pittsfield, Me., September 22, 1895 (Morrell); Taunton, Mass., September 19, 1889 (Scudder); Germantown, Pa., October 2, 1887 (Stone); Key West, Fla., October 3, 1888 (Scott); near Atlanta, Ga., November 27, 1903 (Smith); Escondido, Nicaragua, November 26, 1892 (Richmond); San Jose, Costa Rica, November 15, 1889 (Cherrie); Davila, Panama, November 30, 1900 (Bangs).

**Buff-breasted Sandpiper.** *Tryngites subruficollis* (Vieill.).

*Summer range.*—The buff-breasted sandpiper is known to breed from Point Barrow, Alaska (Murdoch), to near Franklin Bay, Mackenzie (MacFarlane). It was taken in June at Repulse Bay (Rae), and undoubtedly breeds along the whole Arctic coast east to Hudson Bay. Not quite so certain is the breeding of the bird on the coast of northeastern Siberia. It was found to be quite common there near Koliuchin Bay, August 1, 1881 (Nelson), and had probably bred there, but no nests or young were found, and the individuals seen may have been early fall wanderers from Alaskan breeding grounds.

*Winter range.*—It winters in Argentina and Uruguay, south at least to Buenos Aires (Durnford) and Montevideo (Gould).

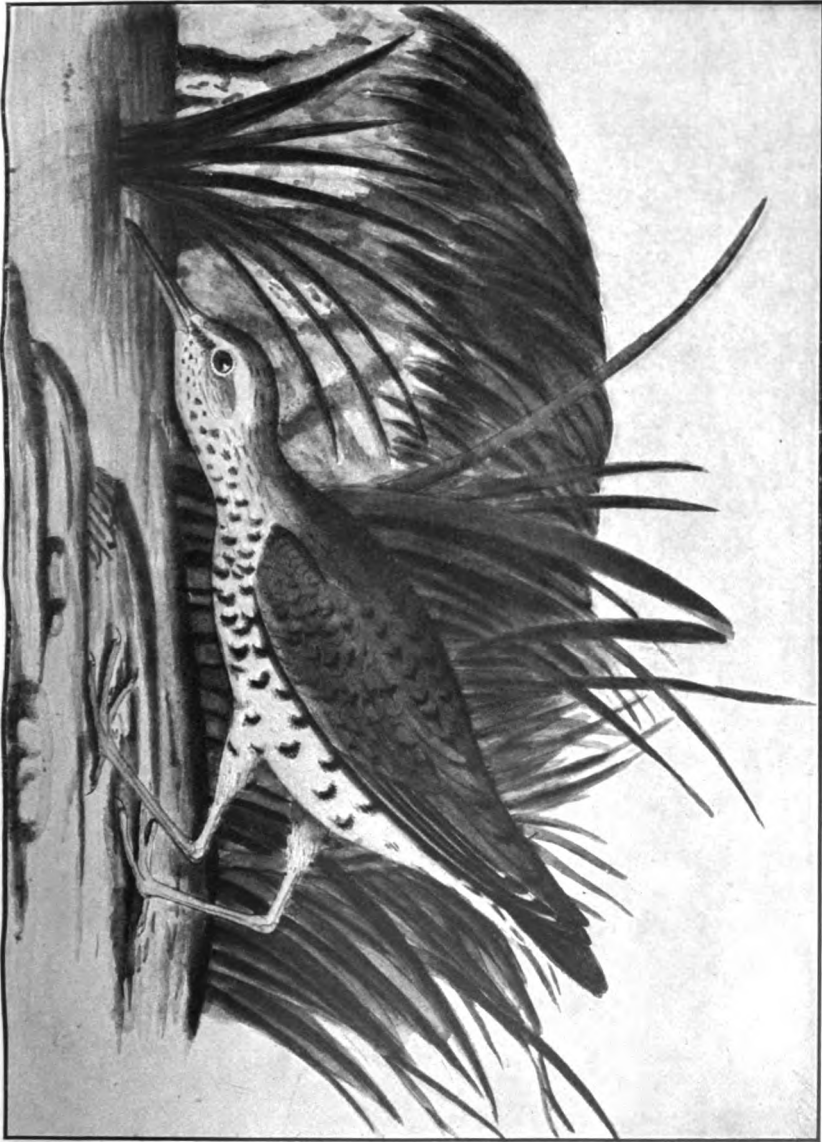
*Migration range.*—Many thousand miles separate the summer and winter homes of the species, and the migration route between these widely separated regions seems to be somewhat different from that of any other species. The main body of migrants follows the Barren Grounds to the shores of Hudson Bay, thence almost due south across the Mississippi Valley to the coast of Texas and through Central America to northwestern South America and diagonally across the interior of South America to Argentina.

The buff-breasted sandpiper is a rare fall migrant on the Atlantic coast: Henley Harbor, Labrador, August 20, 1860 (Coues); Port Burwell, Ungava, September 28, 1884 (Bell); Quebec, three records, August 28 (Merriam) to September (Trowbridge); Cape Elizabeth, Me., September 13, 1887 (Knight); Scarboro, Me., September 5, 1907 (Norton); several records on the coast of New England and on Long Island, the latest of which is September 11, 1904, on Long Island (Braislin). South of Long Island there are no recent records, and most of the older ones are open to suspicion. The species was seen once in April in Cuba (Gundlach), twice in the fall on Barbados (Feilden), and a record for the island of Trinidad (Leotaud) is somewhat doubtful. It is practically unknown in spring on the Atlantic coast of the United States. It is not known in the Rocky Mountain region, but on the Pacific coast it has been taken at Cape Flattery, Wash. (Newberry); in southern British Columbia (Brooks); Sitka (Bischoff), St. Michael (Nelson), and Nulato (Dall and Bannister), Alaska.

*Spring migration.*—Migrants appear in the interior of Brazil (Pelzeln) and in Peru (Selater and Salvin) during March, but there are no spring migration data for the whole distance between Peru and Texas. In the State of Texas the species was noted April 22, 1887, in Refugio County (Sennett), and April 23, 1877, at Gainesville (Ragsdale). The first were seen at Fort Chipewyan, May 24, 1901 (Preble); Fort Simpson, May 29, 1860 (Ross); Yukon delta, May 30, 1879 (Nelson); St. Michael, May 31, 1880 (Nelson); Point Barrow, June 8, 1882 (Murdoch), and June 6, 1883 (Murdoch).

Eggs were taken on the Barren Grounds near Franklin Bay, June 26, 1864, and June 28, 1865 (MacFarlane); and at Point Barrow, June 18, 1883 (Murdoch).

*Fall migration.*—The fall migration of this species and of most other waders begins in July, and so rapidly do the birds move south that they have been noted the last of this month in Nebraska (Bruner, Wolcott, and Swenk); Gainesville, Tex., August 4, 1883 (Ragsdale); San Jose, Costa Rica, September 7, 1890 (Cherrie); and Cienega, Colombia, September 12, 1898 (Allen). The southern part of the



SPOTTED SANDPIPER (*ACTITIS MACULARIA*).



winter range in Argentina is reached early in October (Sclater and Hudson). A very early migrant was taken August 3, at Pebas, Peru (Sharpe). Usually the species is rare east of the Mississippi River, but several flocks were seen August 16-18, 1874, at Maywood, Ill., near Chicago (Fisher).

**Spotted Sandpiper.** *Actitis macularia* (Linn.).

**Breeding range.**—Few shorebirds have so extended a breeding range as the spotted sandpiper. It nests north to Newfoundland (Reeks), the northernmost part of Ungava (Turner), northern Mackenzie (Fort Anderson; MacFarlane), northern Alaska at Fort Yukon (Lockhart), and to the Kowak Valley in northwestern Alaska (Townsend). It breeds south to northern South Carolina (Chester County; Loomis), central Alabama (Greensboro; Avery), southern Louisiana (New Orleans; Beyer), central Texas (Lacey), southern New Mexico (Carlisle; Barrell), central Arizona (San Francisco Mountains; Mearns), and the southern Sierra of California (Walker Pass; Kaeding), and probably on the Colorado River near Needles (Hollister).

**Winter range.**—The spotted sandpiper ranges south in winter to central Peru (La Merced; Berlepsch and Stolzmann), central Bolivia (San Francisco; Salvadori), and to southern Brazil (Sao Paulo; Ihering). It is not rare in northern South America, and is tolerably common in Central America and Mexico; a few winter in the West Indies, and a small number in the eastern United States to the coast of Georgia (Helme) and to Port Royal, S. C. (Eaton), and in the western United States to southern Arizona (Dwight) and southern California (Grinnell).

**Spring migration.**—The spotted sandpiper passes north about the middle of the migration season, as shown by the following dates of arrival: Northern Florida, average March 19 (Pleas); Raleigh, N. C., average April 10, earliest April 3, 1893 (Brimley); near Asheville, N. C., average April 13, earliest April 10, 1891 (Cairns); Washington, D. C., average April 22, earliest April 2, 1905 (McAtee); near Waynesburg, Pa., average April 13, earliest April 6, 1893 (Jacobs); Beaver, Pa., average April 20, earliest April 2, 1888 (Todd); Renovo, Pa., average April 18, earliest April 9, 1904 (Pierce); Erie, Pa., earliest April 18, 1900 (Todd); near New York City, average April 26, earliest April 15, 1891 (Burhaus); central Connecticut, average April 25, earliest April 20, 1901 (Case); near Providence, R. I., average May 2, earliest April 21, 1905 (Mason); eastern Massachusetts, average April 28, earliest April 15, 1893 (Metcalf); Randolph, Vt., average May 5, earliest April 28, 1891 (Paine); southern New Hampshire, average May 4, earliest April 28, 1905 (Perkins); southwestern Maine, average May 1, earliest April 14, 1904 (Norton); Montreal, Canada, average May 13, earliest April 26, 1890 (Wintle); central New Brunswick, average May 11, earliest May 5, 1906 (McIntosh); Pictou,

Nova Scotia, average May 7, earliest May 3, 1895 (Hickman); North River, Prince Edward Island, average May 14, earliest May 11, 1890 (Bain). The earliest date of arrival at New Orleans, La., is March 19, 1904 (Kopman); Athens, Tenn., average April 14, earliest April 10, 1906 (Gettys); Russellville, Ky., April 9, 1906 (Embody); Brookville, Ind., average April 20, earliest April 14, 1883 (Butler); Waterloo, Ind., average April 27, earliest April 5, 1895 (Hine); Chicago, Ill., average April 30, earliest April 19, 1896 (Gault); Oberlin, Ohio, average April 16, earliest April 9, 1904 (Jones); Petersburg, Mich., average April 22, earliest April 15, 1887 (Trombly); southern Ontario, average April 23, earliest April 13, 1896 (Taverner); Ottawa, Ontario, average April 30, earliest April 24, 1897 (White); southern Wisconsin, average April 27, earliest April 23, 1897 (Russell); Lanesboro, Minn., average April 28, earliest April 18, 1886 (Hvoslef); Onaga, Kans., average May 5, earliest April 26, 1896 (Crevecœur); Aweme, Manitoba, average May 8, earliest May 2, 1905 (Criddle); Columbia Falls, Mont., average May 7, earliest May 4, 1896 (Williams); Chilliwack, British Columbia, May 9, 1889 (Brooks); Athabaska Landing, Alberta, May 6, 1901 (Preble); Fort Chipewyan, Alberta, May 23, 1893 (Russell); near Fort Providence, Mackenzie, May 17, 1904 (Mills); Fort Simpson, Mackenzie, May 19, 1904 (Preble); Dawson, Yukon, May 24, 1899 (Cantwell); Kowak Valley, Alaska, May 22, 1899 (Grinnell). The species has been seen south of its breeding grounds as late as May in Brazil (Pelzeln), and to the latter part of June on the northern coast of Venezuela (Robinson). The species regularly remains in Cuba (Gundlach) and the Bahamas to early May (Bonhote) and in Mexico to the latter part of the month (Sharpe). The average date of the last seen in northern Florida is May 12, and the latest May 18, 1904 (Pleas).

The date of the laying of the eggs varies but little over the whole extent of the breeding range, as shown by the following dates when the earliest eggs were found: Near Richmond, Va., May 22, 1881 (Robinson); Erie, Pa., May 24, 1893 (Todd); Lawrenceville, N. J., May 27, 1889 (Phillips); Trenton Falls, N. Y., May 19, 1892 (Williams); Canaan, Conn., May 16, 1887 (Tobey); Fall River, Mass., May 14, 1887 (Durfee); Orono, Me., May 24, 1894 (Knight); Montreal, Canada, June 8, 1890 (Wintle); Dunnville, Ontario, May 17, 1884 (McCallum); Big Charity Island, Michigan, May 20, 1903 (Arnold); Cheyenne, Wyo., May 30, 1889 (Bond); Fort Lapwai, Idaho, May 29, 1871 (Bendire); Fort Resolution, Mackenzie, May 23, 1860 (Kennicott); Fort Anderson, Mackenzie, June 9, 1862 (MacFarlane); Fort Yukon, Alaska, June 15, 1862.

*Fall migration.*—The individual taken on Barbados, West Indies, July 4, 1888 (Feilden), may have been a nonbreeding summer resident, or an early fall migrant, but by the end of July migrants have

appeared in the Lesser Antilles, on the coast of Venezuela (Hartert), and in Mexico (Brown); indeed, in 1892 a specimen was taken in northern Lower California the first day of July (Mearns).

The last seen at Chilliwack, British Columbia, was October 9, 1888 (Brooks); average of the last seen at Columbia Falls, Mont., September 19, latest September 22, 1895 (Williams); Aweme, Manitoba, average September 5, latest September 11, 1903 (Criddle); Lincoln, Nebr., September 29, 1900 (Wolcott); Lawrence, Kans., October 14, 1905 (Wetmore); Lanesboro, Minn., November 2, 1886 (Hvoslef); Ottawa, Ontario, average September 18, latest October 28, 1902 (White); southern Ontario, average September 30, latest October 25, 1902 (Saunders); Oberlin, Ohio, average September 20, latest October 30, 1905 (Jones); Scotch Lake, New Brunswick, October 5, 1901 (Moore); southwestern Maine, average October 1, latest October 6, 1900 (Johnson); eastern Massachusetts, average October 7, latest October 14, 1895 (Farmer); Hartford, Conn., average October 8, latest October 12, 1902 (Case); Ossining, N. Y., October 23 (Fisher); Washington, D. C., October 28, 1906 (Fisher); near New Orleans, La., latest November 5, 1902, November 10, 1903 (Allison).

**Long-billed Curlew.** *Numenius americanus* Bechstein.

**Breeding range.**—The principal summer home of the long-billed curlew is in the interior of the United States on the northern half of the plains. Southward it has been known to breed to Oklahoma (Camp Supply; Wilcox), northwestern Texas (McCauley), central New Mexico (Los Pinos; Woodhouse), southern Arizona (Sulphur Spring; Henshaw), and northwestern California in the Pit River region (Grinnell). To the northward it breeds to central British Columbia (150-mile House; Brooks), southern Alberta (Bow River; Macoun), southern Saskatchewan (Medicine Hat; Macoun), and southern Manitoba (Seton). The long-billed curlew was formerly common in the eastern part of the Mississippi Valley and abundant on the Atlantic coast, but of late years the numbers have been so reduced that now it is merely casual or accidental east of the Mississippi. There are records of the former breeding of the species in northern Iowa (Preston), Wisconsin (Hoy), southern Michigan (Jackson; Davis), and northern Illinois (Ridgway). The species was an abundant migrant on the southern Atlantic coast and less common north to Newfoundland (Reeks), and there are various surmises that it bred at various places, such as the west coast of Florida (Scott), coast of New Jersey (Wilson), and Prince Edward Island (Boardman), but most if not all of these breeding records were based on the presence of the birds in July, and there seems to be no authentic record of eggs anywhere east of Michigan.

**Winter range.**—The species winters on the Atlantic coast from South Carolina (Nuttall) to Florida (Allen); on the coast of Louisiana (Beyer) and Texas (Merrill); in southern Arizona (specimen in United

States National Museum); and in California north to Owen Lake (Fisher) and San Francisco (Newberry). It also ranges south through Mexico to the Pacific coast of Guatemala at Chiapam (Salvin). It is a casual wanderer in the West Indies; Cuba, June, July, October (Gundlach); Jamaica, July, 1863 (March); St. Vincent, once in the fall (Lawrence).

*Spring migration.*—When the long-billed curlew was common on the Atlantic coast, it was seldom seen in spring north of the Carolinas; the few individuals that passed up the New England coast usually appeared in May: Hail Point, Maryland, May 23, 1893 (Kirkwood); Scarboro, Me., May 2, 1866 (Knight). Migration in the Mississippi Valley begins in March: Eagle Pass, March 5, 1885 (Negley); Pecos City, March 9, 1906 (Ligon); Gainesville, March 4, 1876 (Ragsdale)—all in Texas; Warrensburg, Mo., April 1, 1874 (Scott); Appleton City, Mo., April 3, 1906 (Prier); central Illinois, average April 9; Jasper, Ind., April 2, 1896 (Butler); central Iowa, average April 11, earliest April 3, 1883 (Lindley); northern Nebraska, average April 3, earliest March 28, 1889 (Bates); Vermilion, S. Dak., April 5, 1884 (Agersborg); central North Dakota, average April 15, earliest April 8, 1886 (Edwards); Aweme, Manitoba, average April 22, earliest April 9, 1902 (Criddle); Apache, N. Mex., March 25, 1886 (Anthony); Utah Lake, Utah, March 30, 1899 (Johnson); northern Colorado, average April 14, earliest April 10, 1889 (Smith); Cheyenne, Wyo., average April 18, earliest April 15, 1889 (Bond); Terry, Mont., average April 16, earliest April 7, 1906 (Cameron); Big Sandy, Mont., average April 19, earliest April 13, 1903 (Coubeaux); Fort Klamath, Oreg., March 28, 1887 (Merrill); Chelan, Wash., April 6, 1896 (Dawson); Okanagan Landing, British Columbia, April 12, 1906 (Brooks).

Eggs have been taken at Camp Harney, Oregon, April 30, 1876 (Bendire); Fort Klamath, Oreg., May 7, 1878 (Mearns); Lewistown, Mont., May 13, 1902 (Silloway); Fort Lapwai, Idaho, May 21, 1871 (Bendire); Cody, Nebr., young just hatched June 23, 1895 (Trostler); southern Saskatchewan, downy young June 1, 1905 (Bent); June 11 and 18, 1906 (Bent).

*Fall migration.*—Flocks of fall migrants used to appear on the Atlantic coast about the middle of July (Mearns) and reach South Carolina by early August (Hoxie). They returned to Monterey Bay, California, July 17, 1894 (Loomis), and arrived at Cape St. Lucas, Lower California, September 15, 1859 (Xantus). The last one seen at Montreal in 1893 was observed September 21 (Wintle), and on the coast of Massachusetts the species has been noted to October 18 (Howe and Allen).

**Hudsonian Curlew.** *Numenius hudsonicus* Lath.

*Breeding range.*—The Hudsonian curlew, or jack curlew as it is called by sportsmen, is known to breed on the barren grounds of northern Mackenzie (MacFarlane) and on the western coast of

Alaska from the mouth of the Yukon (Nelson) north to Kotzebue Sound (Grinnell).

*Winter range.*—The principal winter home is on the Pacific coast, where the species ranges from Ecuador (Salvadori and Festa) to southern Chile (Chiloe Island; Pelzeln), and is especially abundant toward the southern limit of the range. At this season it occurs also on the coasts of Honduras (Taylor) and Guatemala (Salvin) and north to the southern portion of Lower California (Belding). On the Atlantic coast it occurs during the winter from British Guiana (Quelch) to the mouth of the Amazon (Sharpe).

*Migration range.*—The species probably does not breed in Greenland, but it has been taken several times on the western coast as far north as Jacobshaven, latitude 69° N. (Winge). It migrates east to Ungava (Turner) and Newfoundland (Reeks), and passes down the Atlantic coast and through the Lesser Antilles to its winter home; but it is almost unknown in the Greater Antilles and in Central America and northwestern South America from Nicaragua to Venezuela. It is a common migrant and a probable breeder along the western shore of Hudson Bay (Preble), but since it is unknown in Saskatchewan and Manitoba it is evident that these Hudson Bay birds turn southeastward and probably reach the New England coast; for the bird is more common on the Massachusetts coast than would be expected from the few individuals that occur in Labrador. The species is scarcely recorded in the whole Rocky Mountain district between central Nebraska and eastern California, and it is a rare migrant in the Mississippi Valley, though a few use this route in both migrations. The main migration route is along the Pacific coast, and it occurs here west to St. Paul Island, Alaska (Palmer).

*Spring migration.*—Records of arrival in the eastern United States are: Sarasota Bay, Florida, March 22, 1872 (Moore); Port Royal, S. C., April 14 (Mackay); Cobbs Island, Virginia, May 19, 1891 (Kirkwood); Cape May, N. J., April 12, 1907, "ten days ahead of the usual time" (Hand); Shelter Island, N. Y., May 9, 1887 (Worthington); Nantucket, Mass., April 10, 1891 (Mackay); but usually not in Massachusetts before the middle of May. By what route these birds reach the eastern United States coast is as yet unknown, for there are no corresponding records in either the Lesser or the Greater Antilles.

The main migratory flocks reach the coast of southern California the middle of March (Grinnell) and proceeding slowly northward have been noted at Fort Kenai, Alaska, May 18, 1869 (Bischoff); Nulato, Alaska, May 12, 1866 (Pease); Kowak Valley, Alaska, May 17, 1899 (Grinnell); Fort Anderson, Mackenzie, May 29, 1865 (MacFarlane).

Eggs were taken on the barren grounds west of the lower Anderson River in late June and early July (MacFarlane), and in the Kowak Valley June 14–20, 1899 (Grinnell).

*Fall migration.*—On the western shore of Hudson Bay near York Factory in 1900 the species was seen July 19, and was tolerably common in that region nearly to the first of September (Preble); the earliest date at Toronto, Ontario, is July 4, 1904 (Fleming). The average date of arrival at Nantucket, Mass., is July 20, earliest July 13 (Mackay); earliest at Long Beach, N. J., July 9, 1879 (Stone); Pea and Bodie Island, North Carolina, July 22, 1904 (Bishop); Bermudas, August 14 (Reid); Barbuda, West Indies, August 12, 1877 (Ober). Two specimens were taken July 3, 1907, at Coronado de Terraba, Costa Rica (Carriker), but these may have been nonbreeders that had not made a northern journey.

The individuals breeding in Alaska pass south along the Pacific coast, and have been noted at the Farallons, California, July 16, 1896 (Loomis); Los Coronados Islands, Lower California, August 7, 1902 (Grinnell and Daggett); Chimbote, Peru, August 2-5, 1883 (MacFarlane); and by August 18, at Arauca, Chile (Sharpe).

The Hudsonian curlew has been noted at St. Michael, Alaska, as late as September 2, 1899 (Bishop); Morro Bay, California, November, 1891 (Nelson); Great Bear Lake, August 30, 1903 (Preble); near Cape Churchill, Hudson Bay, August 24, 1900 (Preble); Henley Harbor, Ungava, August 27, 1860 (Coues). Near Newport, R. I., a gunner secured 30 birds in eight years on dates ranging from August 26, 1867, to October 2, 1874 (Sturtevant). Barbuda, West Indies, November 12, 1903 (specimen in United States National Museum).

**Eskimo Curlew.** *Numenius borealis* (Forst.).

*Breeding range.*—The principal summer home of the Eskimo curlew was on the barren grounds of Mackenzie, from near the Arctic coast (MacFarlane) south to Point Lake (Richardson). Thence a few ranged west as far as Point Barrow (Murdoch), but no nests seem to have been found west of Mackenzie.

*Winter range.*—Most of the species wintered in the campos region of Argentina (Sclater and Hudson) and Patagonia, south at least to the Chubut Valley (Durnford). It has been taken once on the Falkland Islands (Abbott). It was rare in Chile, south to Chiloe (Philippi). At present there are no data to determine the northern limit in winter, but probably few if any wintered much north of Buenos Aires.

*Migration route.*—The curlew left the Barren Grounds in the fall and went southeast to Labrador (Coues), where they gorged themselves for several weeks and became extremely fat. Then they passed across the Gulf of St. Lawrence and struck out to sea heading for the Lesser Antilles, nearly 2,000 miles distant. Some flocks stopped for a few days at the Bermudas (Jardine), but if the weather was fair the larger number passed on, flying both day and night, and did not land during the whole trip. When storms interfered, the birds were sometimes driven out of their course and appeared in

considerable numbers on the coast of Massachusetts (Mackay) and less often on Long Island (Giraud) and the New Jersey coast (Turnbull). The Eskimo curlew was absent, except as a straggler, from the whole coast of the United States south of New Jersey, from the Bahamas and from the Greater Antilles. In its southward flight it passed through the Lesser Antilles (Feikden) and along the eastern portion of Brazil (Pelzeln) to its winter home. Throughout the whole line of its fall migration it was unknown in spring, at which season it was traveling northward some thousands of miles farther west over the prairies of the Mississippi Valley. The exact route between its winter home and the United States is unknown, for along the whole 4,000 miles from Argentina to northern Mexico and southern Texas the species has been recorded only twice—once in Costa Rica (Zeledon) and once in Guatemala (Salvin). Its principal migration route in spring was a comparatively narrow belt crossing the prairies on both sides of the meridian of  $97^{\circ}$ . The course is well known from southern Texas (Merrill) to southern South Dakota (Agersborg) and thence data are wanting. There seem to be no records of the species from about latitude  $44^{\circ}$  in the Mississippi Valley until Great Slave Lake is reached, a thousand miles to the northward.

This curlew is unknown in the Rocky Mountain States or anywhere on the Pacific slope or coast south of Alaska, and the specimen taken April 8, 1892, at Lake Palomas, Chihuahua (specimen in United States National Museum), was far out of the usual course of the species. The species has been taken a few times in western Alaska, south to St. Michael (Nelson) and west to the Pribilof Islands (Palmer) and Bering Sea (specimen in United States National Museum). It has occurred accidentally several times in Europe and on the western coast of Greenland, north to Disco Bay (Winge).

*Spring migration.*—The Eskimo curlew arrived in Texas in March—Boerne, March 9, 1880 (Brown); Gainesville, average March 17, earliest March 7, 1884 (Ragsdale); and reached central Kansas about the middle of April—April 14, 1884 (Kellogg); April 13, 1885 (Kellogg). Most of the records in the central Mississippi Valley are in April. One of the latest and most northern is that of Coues, who says that he saw them in large flocks the second week in May, 1873, between Fort Randall and Yankton, S. Dak. Then there is no further news of them until they arrived at Fort Resolution, Mackenzie, May 27, 1860 (Kennicott); Fort Anderson, May 27, 1865 (MacFarlane); Point Barrow, May 20, 1882 (Murdoch).

Eggs were taken at Point Lake, Mackenzie, June 13, 1822 (Richardson), and on the Barren Grounds near Fort Anderson, June 13, 1863, June 16, 1864, and June 16, 1865 (MacFarlane).

*Fall migration.*—The Eskimo curlew started so early in August that by the middle of the month the old birds reached the eastern

shores of Labrador (Coues). During the following two weeks they crossed the Gulf of St. Lawrence and made their long ocean flight and by the end of another fortnight they were at the winter home in Argentina (Sclater and Hudson). Dates of arrival along this course are: Indian Tickle Harbor, Labrador, August 16, 1860 (Coues); Houlton Harbor, Labrador, August 20, 1891 (Norton); Nantucket, Mass., average August 29, earliest August 18, 1898 (Mackay); Barbados, West Indies, August 27, 1886 (Manning); Amazon River, September 4, 1830 (Pelzeln); Concepcion, Argentina, September 9, 1880 (Barrows). Some dates of the last seen are: Fort Churchill, Keewatin, September 1, 1884 (Bell); Newfoundland, to end of September (Reeks); Saybrook, Conn., October 13, 1874 (Merriam); Barbados, West Indies, November 4, 1886 (Manning). Many curlews migrated south along the west coast of Hudson Bay, before they turned east to the Atlantic and some of these seem to have wandered occasionally southward and given rise to such records as Kingston, Ontario, October 10, 1873 (Fleming); Erie, Pa., September 17, 1889 (Sennett); and a few fall records around Lake Michigan.

The Eskimo curlew is rapidly approaching extinction, if indeed any still exist. In the early sixties MacFarlane found them breeding abundantly on the Barren Grounds near Fort Anderson, while Coues reports thousands passing south along the Labrador coast in the fall; in the early seventies Coues found them equally abundant passing north through South Dakota in the spring. Ten years later they were still common in their winter home in Argentina, and naturalists who visited the Labrador coast at this time record them as present in flocks but not in numbers as seen by Coues. By 1889 only a few flocks were seen, and within the next half dozen years the flights ceased. During the last fifteen years the species has been recorded only a few times and apparently only three times in the ten years previous to 1909: Tuckernuck Island, Massachusetts, eight birds August 24, 1897 (Mackay); Nantucket, Mass., two, August 18, 1898 (Mackay); northeastern coast of Labrador, about a dozen the fall of 1900 (Bigelow). The latest records are those of two birds shot August 27, 1908, at Newburyport, Mass. (Thayer), and one September 2, 1909, at Hog Island, Maine (Knight). The disappearance of the Eskimo curlew has given rise to much speculation as to the probable cause. A simple explanation is that during recent years, especially since 1880, its former winter home in Argentina has been settled and cultivated, while its spring feeding grounds in Nebraska and South Dakota have been converted into farm land.

[**European Curlew.** *Numenius arquatus* (Linn.).

This Eastern Hemisphere species breeds from Great Britain to southern Russia, the White Sea, and the Ural Mountains. It winters in Great Britain and occurs at this season from the Mediterranean to the south end of Africa.

It is probable that one specimen of this curlew was collected on Long Island in 1853—its only North American record.]

**Whimbrel.** *Numenius phaeopus* (Linn.).

Though an Old World species, the whimbrel is a common visitor in Greenland (Schalow) and possibly breeds there. It breeds in Iceland, Scandinavia, and Russia, east to the Ural Mountains and north to the Arctic Circle. It winters on the coast and islands of tropical and southern Africa, and ranges at this season east to India and the Malay Peninsula. One was taken May 23, 1906, about latitude 43° N. and longitude 60° W., south of Sable Island, Nova Scotia (Brewster).

**Bristle-thighed Curlew.** *Numenius tahitiensis* (Gmel.).

The breeding range of this species has not yet been ascertained, but in Alaska it has been taken May 18, 1869, on the Kenai Peninsula (Bischoff); May 24, 1880, at St. Michael (Nelson); August 26, 1885, on the Kowak River (Townsend); and May 23, 1905, at the head of Nome River (Anthony). These dates would seem to indicate that the species nests in the northern part of its range.

The species is common on the Hawaiian Islands and occurs throughout the islands of the Pacific south to New Caledonia and from the Ladrões to the Marquesas and Paumotu islands. The Pacific islands seem to be the winter home of the species, and on some of them it is quite common. It has been taken in the Phoenix group near the equator in June and July, and a few are known to remain all summer in Hawaii (Henshaw), but these apparently are non-breeding birds.

**Lapwing.** *Vanellus vanellus* (Linn.).

Though an Old World species, the lapwing has been noted several times in Greenland on the west coast from Julianehaab to Godthaab, at various times from early December to the first of April (Schalow). It has been taken as a straggler at White Hills, Newfoundland, November 23, 1905 (Brewster); Halifax, Nova Scotia, March 17, 1897 (Piers); Merrick, Long Island, about December 26, 1883 (Dutcher); Meccox Bay, Long Island, fall of 1905 (Beebe); Hog Island, Bahamas, November, 1900 (Fleming); Barbados, 1886 (Cory).

The breeding range extends from Great Britain to Japan, from central Europe to the Arctic Circle, and from northern China to about latitude 55° in Siberia. The species winters from about the southern limit of the breeding range to northern Africa and southern China.

**Dotterel.** *Eudromias morinellus* (Linn.).

This is an accidental visitor to North America, the only record being that of one taken July 23, 1897, on King Island, Alaska (Stone). It breeds from Great Britain, southern Russia, and eastern Siberia north to the islands of the Arctic coast. It winters from southern Europe to equatorial Africa.

**Black-bellied Plover.** *Squatarola squatarola* (Linn.).

*Breeding range.*—This is a circumpolar species, but the places where it is known to breed are comparatively few. In North America it has been found breeding on the Melville Peninsula (Richardson), Boothia Felix (Ross), Franklin Bay (MacFarlane), and Point Barrow (Murdoch). In the Eastern Hemisphere it breeds on the Kolgnjef and Dolgoi islands of Russia and near the Taimyr Peninsula, Siberia, and probably breeds on the Liakoff Islands, Siberia, and near the south end of Nova Zembla Island.

*Winter range.*—The North American breeding birds pass south in winter to Chimbote and Tumbez, in northern Peru (Taczanowski), and to the Amazon River, Brazil (Pelzeln). The species is also found at this season through northern South America, the West Indies, Central America, and Mexico to the coast of South Carolina (Coues), occasionally North Carolina (Bishop), southern Texas (Sennett), and the coast of California north to Humboldt County (Townsend). It probably wintered formerly to the mouth of the Columbia (Suckley). The birds of Russia and Siberia winter from the Mediterranean, India, and southern China to southern Africa and Australia. The species is accidental in Hawaii (Henshaw).

*Migration range.*—The black-bellied plover has been taken several times on the west coast of Greenland north to Egedesminde, latitude 69° N. (Winge), but probably does not breed in that country. It is known only as a migrant along the east coast of Siberia, as at Plover Bay (Nelson) and on the Commander Islands (Stejneger).

*Spring migration.*—The species is a late and not common migrant on the Atlantic coast in the spring, and appears in New Jersey (Stone) and on Long Island in late April and early May; Montauk, N. Y., April 30, 1902 (Scott); Cape Cod, Massachusetts, average May 23, earliest April 18, 1894 (Mackay); Pictou, Nova Scotia, May 17, 1895 (Hickman). Nor is it common in the interior, where some dates of spring arrivals are: Near New Orleans, La., March 2, 1890 (Beyer); Sedalia, Mo., March 21, 1884 (Sampson); southern Ontario, average May 27, earliest May 22 (Fleming); Vermilion, S. Dak., May 3, 1884 (Agersborg); northern North Dakota, average May 8, earliest May 5, 1894 (Bowen); Reaburn, Manitoba, average May 19, earliest May 14, 1901 (Wemyss); Cheyenne, Wyo., average May 18, earliest May 11, 1884 (Bond); Indian Head, Saskatchewan, average May 14, earliest May 9, 1904 (Lang); Fort Chipewyan, Alberta, May 23, 1901 (Preble); Fort Resolution, Mackenzie, June 2, 1860 (Kennicott); Sitka, Alaska, May 6, 1869 (Bischoff); mouth of the Yukon, May 12; Dawson, Yukon, May 20, 1899 (Bishop); Point Barrow, Alaska, June 21, 1882 (Murdoch), and June 26, 1898 (Stone).

Some individuals remain late in the spring on the Atlantic coast and possibly some nonbreeders may remain the entire summer. In Florida they have been seen June 14, June 29, July 4, July 26, and

August 3 (Scott and Worthington). They have been seen in Jamaica in June (Field), and even off the coast of Venezuela they were common June 21-27, 1892 (Hartert). The last of the regular migrants do not leave the coast of Massachusetts until June—average June 6, latest June 15, 1886 (Cahoon); Western Egg Rock, Maine, June 24, 1895 (Knight); Toronto, Ontario, June 2 (Fleming); Corpus Christi, Tex., July 1, 1887 (Sennett).

Eggs were taken at Franklin Bay, Mackenzie, July 4, 1864, and July 8, 1865 (MacFarlane), but in each case the eggs were already partly incubated.

*Fall migration.*—The southward movement begins early in July, bringing a few individuals into the United States the latter part of that month—eastern Massachusetts, July 8 (Howe and Allen); Toronto, Ontario, July 23, 1890 (Fleming)—but the regular migration occurs in August: Cape Cod, Massachusetts, average August 17, earliest August 6 (Mackay); Long Island, New York, average August 6, earliest July 1, 1905 (Kobbe); Erie, Pa., August 1, 1890 (Todd); southern Wisconsin, August 10, 1872 (Kumlien and Hollister); southern British Columbia, August 15, 1903 (Brooks). The last were seen at Winter Island on the coast of Melville Peninsula August 17, 1821 (Greely), and the first flocks came along the Labrador coast August 15, 1860 (Coues). The species was unusually abundant on Prince Edward Island in 1892 from August 22 to September 14 (Mackay). Some dates of the last seen are: Point Barrow, Alaska, August 20, 1897 (Stone); Great Bear Lake, Mackenzie, September 5, 1903 (Preble); St. Michael, Alaska, September 16, 1899 (Bishop); southern British Columbia, October 23, 1888 (Brooks); Fort Collins, Colo., October 28, 1893 (Cooke); Lincoln, Nebr., October 21, 1899 (Wolcott); Ottawa, Ontario, average October 24, latest November 8, 1903 (White); Pictou, Nova Scotia, October 11, 1894 (Hickman); Cape Cod, Massachusetts, average October 21, latest November 14, 1887 (Cahoon)—accidental in December, 1872 (Mackay); Erie, Pa., November 10, 1894 (Todd); Long Island, New York, average October 15, latest November 7, 1905 (Latham).

**European Golden Plover.** *Charadrius apricarius* Linn.

The combined ranges of the three golden plovers complete the circumference of the globe in the vicinity of the Arctic Circle. In general it may be said that *apricarius* breeds in northern Europe and northwestern Siberia; *dominicus* in North America; and *fulvus* in eastern Siberia. The ranges of *apricarius* and *dominicus* meet on the west coast of Greenland; *dominicus* and *fulvus* join ranges in western Alaska; the dividing line in Siberia between *fulvus* and *apricarius* has not yet been determined.

The European golden plover breeds from Great Britain to western Siberia and south to central Europe. It winters from about the

southern limit of the breeding range south to Beluchistan and northern Africa. This plover has been taken as a summer visitor to the east coast of Greenland (Helms), and at several places on the west coast from the southern end to Christianshaab about 69° latitude (Winge). It has not yet been found breeding in Greenland, though it has been taken there in midsummer (Helms).

**Golden Plover.** *Charadrius dominicus* Müll.

*Breeding range.*—The summer home of the golden plover extends from Whale Point at the northwest corner of Hudson Bay (Eifrig), west across the barren grounds to the mouth of the Anderson River (MacFarlane), and thence along the barren grounds of the coast of Alaska to Kotzebue Sound (Grinnell). It extends north in Franklin to include the islands, at least as far as latitude 77°. The bird is known to breed commonly on Banks Island (Armstrong), Prince Albert Island (Armstrong), Melville Island (Parry), and the islands at the north end of Wellington Channel (Belcher), and east to the eastern coast of Melville Peninsula (Parry). It probably does not breed in Greenland, though it occurs not uncommonly on the west coast to about latitude 73° (Walker). There are somewhat doubtful records of the species having been seen August 7, 1881, at Cape Baird, Lady Franklin Bay, 81° 30' N. (Greely), and on July 12, 1872, at Thank God Harbor, Greenland, 81° 40' (Davis). As the belt of tundra along the north coast of Alaska is comparatively narrow, the principal breeding grounds of the golden plover are between the mouth of the Mackenzie River and the Gulf of Boothia, north of the Arctic Circle.

*Winter range.*—The species ranges south on the Atlantic coast to Bahia Blanca, central Argentina (Barrows), and the center of abundance during the winter season is the pampas of Argentina (Sclater and Hudson) and Uruguay (Aplin), between the parallels of 34° and 36° S. Individuals remain during the winter as far north as Rio Janeiro, Brazil (Hapgood), on the coast and to Cuyaba, Matto Grosso (Pelzeln), in the interior. There is one record of the occurrence of the species (probably casual) in January at Nauta in northeastern Peru (Sharpe). The golden plover does not winter in the Lesser Antilles nor in that part of northeastern South America where it is most abundant in migration. It has been recorded as wintering at several places north of South America, but probably such of these records as are not errors represent accidental or unusual occurrences.

*Migration range.*—From the breeding grounds the golden plover go south and southeast to Labrador; then cross the Gulf of St. Lawrence and its islands to Nova Scotia, and from the southern coast of the latter fly directly across the ocean to the Lesser Antilles and the coast of northeastern South America. Sometimes when caught by a storm during this flight they seek the nearest land, appearing not

infrequently at the Bermudas, Cape Cod, and Long Island. After a short stop in the Antilles and northern South America, they pass to the winter home in Argentina and remain there from September to March.

The return northward in spring is by a different route, the details of which are not yet determined. What is known is that they disappear from Argentina and shun the whole Atlantic coast from Brazil to Labrador. In March they appear in Guatemala and Texas; April finds them on the prairies of the Mississippi Valley; the first of May sees them crossing our northern boundary; and by the first week in June they reappear on their breeding grounds in the frozen north.

Various theories have been advanced to account for this strange migration course. The simplest explanation seems to be the application of the following, which may be laid down as the fundamental law underlying the choice of migration routes. Birds follow that route between the winter and summer homes that is the shortest and at the same time furnishes an abundant food supply. Applying this rule to the case of the golden plover, the following facts are apparent: The plover is a bird of treeless regions; it summers on the tundras and winters on the pampas; an enormous food supply especially palatable tempts it in the fall to Labrador and furnishes power for the long flight to South America. To attempt to return in spring by the same course would be suicidal, for at that season Labrador would furnish scant provender. The plover seeks the shortest treeless route overland, and alighting on the coast of Texas travels leisurely over the Mississippi Valley prairies, which are abundantly supplied with food, to the plains of the Saskatchewan and thence to the Arctic coast.

*Spring migration.*—The principal line of migration from the winter home northward through South America is not yet known; the species is said to be common in March and April in Peru (Sclater and Salvin) east of the mountains, but next to nothing is known regarding its appearance in the territory for a thousand miles to the northward. The species is practically unrecorded at all seasons of the year from Ecuador, Colombia, Panama, Nicaragua, and Honduras, and though a few have been noted in Costa Rica (Cherrie), Guatemala (Sclater and Salvin), and eastern Mexico (Sclater), in none of these countries have the great flocks been seen that are so characteristic of the fall flight in the Lesser Antilles and of the spring advance up the Mississippi Valley. Not until Texas is reached can the movements of the golden plover be definitely traced, and at no place between Peru and Texas has it ever been recorded as common. In fact, the records as they stand are what they should be if the plover escapes the forested regions of northern South America and Central America by a single flight of from 2,000 to 2,500 miles from the valleys of eastern Peru to the treeless prairies of Texas. The general time of appearance in the

United States and of passage to the summer home can be gathered from the following dates of arrival: Boerne, Tex., March 9, 1880 (Brown); Indianola, Tex., March 15, 1856 (Cassin); Gainesville, Tex., March 17, 1885 (Ragsdale); Caddo, Okla., March 12, 1884 (Cooke); near New Orleans, La., March 24, 1894 (Allison), April 2, 1881 (Langdon); Fayetteville, Ark., abundant March 20-31, 1883 (Harvey); central Missouri, average April 13, earliest April 11, 1903 (Bryant); Badger, Nebr., average April 8, earliest April 5, 1903 (Colt); Lebanon, Ill., March 17, 1876 (Jones); Tampico, Ill., average April 10, earliest March 31, 1885 (Brown); Terre Haute, Ind., March 23, 1888 (Evermann); Chicago, Ill., average April 16, earliest March 30, 1899 (Gault); central Iowa, average April 19, earliest April 12, 1883 (Williams); Heron Lake, Minnesota, average May 1 (Miller); central South Dakota, average April 30, earliest April 25, 1888 (Bishop); Larimore, N. Dak., average May 5, earliest May 2, 1895 (Eastgate); Aweime, Manitoba, average May 4, earliest April 23, 1905 (Criddle); Indian Head, Saskatchewan, May 9, 1904 (Lang); Fort Simpson, Mackenzie, May 26, 1860 (Ross), May 19, 1904 (Preble); Fort Reliance, Yukon, May 13 (Nelson); Point Barrow, Alaska, latitude 71° N., May 21, 1882 (Murdoch), May 24, 1883 (Murdoch), June 1, 1898 (Stone). The dates of arrival in the province of Franklin are: Igloodik, 69°, June 14, 1823 (Parry); Boothia Felix, 70°, June 4, 1830 (Ross), June 22, 1831 (Ross); Prince of Wales Strait, 73°, June 7, 1851 (Armstrong); Bay of Mercy, 74°, June 3, 1852 (Armstrong); Winter Harbor, 75°, June 2, 1820 (Parry); near Wellington Channel, 77°, June 2, 1853 (Belcher).

The latest dates recorded in the southern part of the winter range are March 12 (Aplin) and March 19 (Barrows); in the northern part of the winter home the species remains until April (Sclater and Salvin); at Chicago the average date of the last one seen is April 30, and the latest May 9, 1895 (Blackwelder). Some other late dates are: Near New Orleans, La., June 10, 1907 (Kopman); Lebanon, Ind., May 10, 1894 (Beasley); Lawrence, Kans., May 8, 1906 (Wetmore); White, S. Dak., May 27, 1889 (Partch); Aweime, Manitoba, average May 23, latest May 29, 1896 (Criddle); Fort Chipewyan, Alberta, June 1, 1893 (Russell). South of the latitude of Chicago the bulk of the spring shooting of golden plover is in April; from Iowa northward to Canada the spring shooting occurs chiefly during the first half of May.

During the spring migration the golden plover is almost entirely absent from the Atlantic coast. There are three spring records for Massachusetts (Mackay) and a few for Long Island (Giraud), the last of them many years ago. Probably most of the other scattered spring records east of the Alleghenies are errors of identification. The species is not common at any time of the year west of Texas,

Nebraska, and Saskatchewan, and apparently is absent in spring from the whole region west of the Rocky Mountains.

Eggs were collected on the lower Anderson River, Mackenzie, June 24, 1863, June 22, 1864, and June 16, 1865 (MacFarlane); at Point Barrow, Alaska, June 22, 1882, and June 23, 1883 (Murdoch).

*Fall migration.*—The old birds start south in July, and those that are to make the flight from Nova Scotia to the Lesser Antilles occupy about a month in the trip from the breeding grounds to the southern coast of Nova Scotia. If fair weather prevails, the flocks of golden plover pass by the New England coast far out at sea, but severe storms are frequent at this season, and the birds are often driven to land. The average for twenty-eight years of the date of arrival of these storm-driven migrants at Nantucket, Mass., is August 25, earliest August 12, 1898 (Mackay); a still earlier date is August 7, 1852, at Plymouth, Mass. (Browne). Five times in these twenty-eight years birds were seen before August 20 (Mackay). The rule on Long Island is to expect the plover with the first storm occurring after August 28 (Lawrence). The first flocks are noted in the Bermudas during the last ten days of August (Reid), and about the same time the species arrives in the Lesser Antilles (Lawrence) and even on the coast of British Guiana (Quelch). A few golden plover reach Argentina the last week in August (Sclater and Hudson) and the species has been taken in Bolivia in August (Allen), but these early couriers are exceptional, and the main flocks arrive in September.

On the west side of Baffin Bay in 1820 the last was seen September 3 (Parry); in Nova Scotia the species sometimes remains until October (McKinlay). The average date of the last one seen at Nantucket, Mass., for ten years previous to 1890 is October 2, latest October 22, 1878 (Mackay); for the years since 1890 the average date of the last seen is September 23 (Mackay). Near Newport, R. I., a market hunter shot 386 golden plover during 1867 to 1874; the dates ranged from August 14, 1868, to October 24, 1874 (Sturtevant). On Long Island the dates of the earliest and latest recorded observations of the species are August 15 and November 10 (Chapman). In the Bermudas and the Lesser Antilles most of the birds leave in October, though some stragglers may be noted in November.

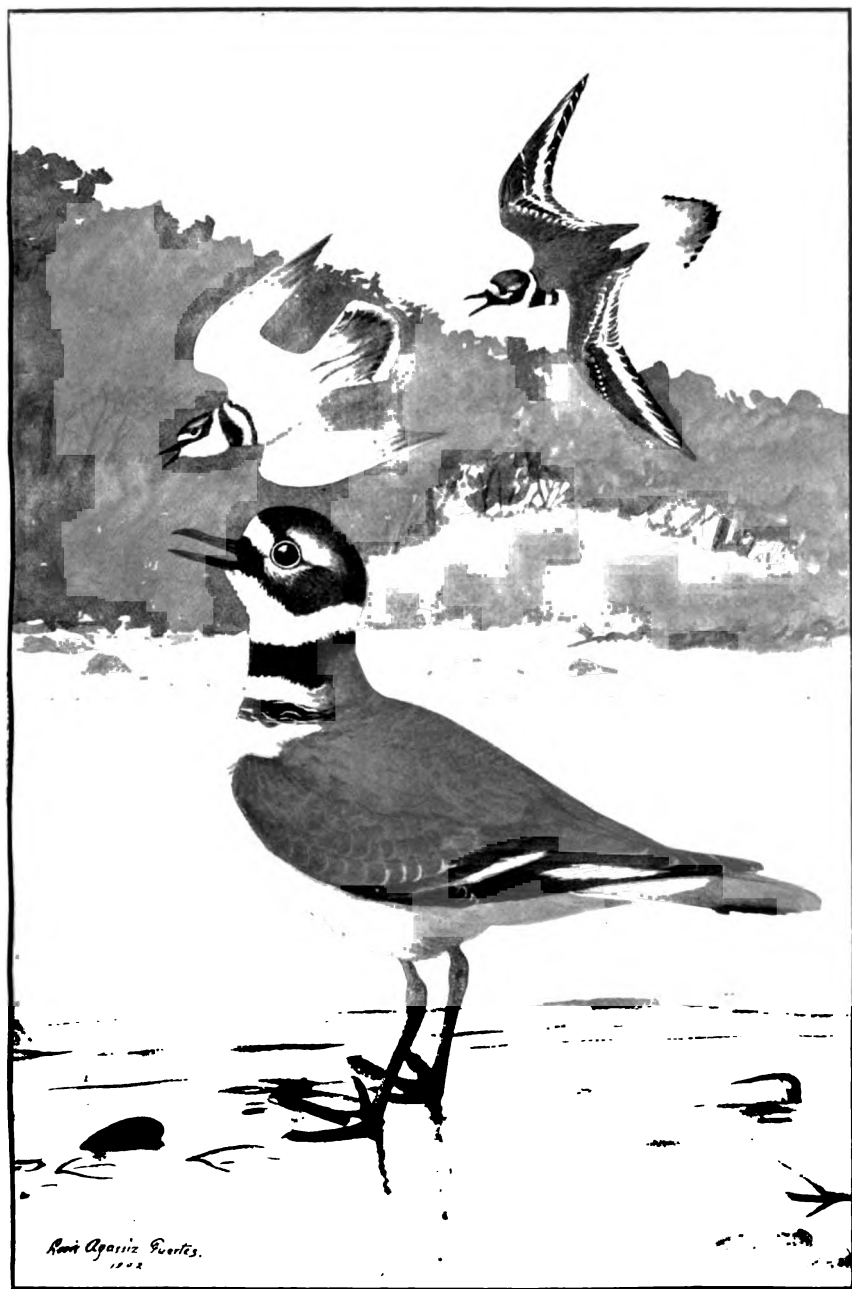
In the interior of New England the golden plover is rare in fall, though at times it is quite common on Lake Champlain. Throughout New York, Pennsylvania, and New Jersey it is usually very rare, but in 1880 and in several other years it has been common in those States. It has been seen at Erie, Pa., on dates ranging from August 20, 1896, to November 18, 1900 (Todd). South of New Jersey on the Atlantic coast, also in the Bahamas, the golden plover is almost unknown, and it is not common anywhere in the Greater Antilles west of St. Croix.

While the greater number of golden plover migrate across the Atlantic, a few pass south in the fall through the interior of North America. The first arrival from the north noted near Fort Churchill, Keewatin, in 1900, was on August 4 (Preble). Other dates of fall arrival in the interior are: Moose Factory, Ontario, September 8, 1860 (Drexler); Aweme, Manitoba, average September 9, earliest August 10, 1904 (Criddle); Lincoln, Nebr., September 22, 1900 (Wolcott); near Toronto, Ontario, August 31, 1891 (Nash), September 1, 1898 (Nash); Point Pelee, Ontario, September 15, 1905 (Swales), September 19, 1906 (Taverner); Chicago, Ill., average September 12, earliest September 10, 1898 (Gault); Bay St. Louis, Miss., September 26, 1899 (Allison); San José, Costa Rica, October 20, 1890 (Cherrie). Probably these Mississippi Valley fall birds are the ones that are fairly common in Peru from September to November (Sclater and Salvin) and that were noted in October at Arica, Chile (MacFarlane).

The form of the golden plover that breeds on the northern and northwestern coasts of Alaska does not seem to migrate along the western coast of Alaska, but passes in general east to Mackenzie. A few individuals migrate southeast and occur in the fall as rare stragglers on the Pacific slope: Sitka, Alaska, August 16, 1896 (Grinnell); Chilliwack, British Columbia, August 26, 1889 (Brooks); Port Townsend, Wash., September 9, 1897 (Fisher); Santa Cruz, Calif., October 22, 1888 (McGregor); San José del Cabo, Lower California, October 18, 1887 (Brewster).

The golden plover does not remain late in the north. The last seen on the breeding grounds at Point Barrow, Alaska, were noted August 28, 1882 (Murdoch), and August 20, 1897 (Stone). Some other dates of late occurrence are: Great Bear Lake, September 6, 1903 (Preble); Fort Simpson, September 10, 1860 (Ross); Edmonton, Alberta, September 23, 1894 (Loring); Indian Head, Saskatchewan, October 2, 1904 (Lang); Aweme, Manitoba, average October 14, latest October 16, 1901 (Criddle); near Fort Pierre, S. Dak., October 21, 1855 (Cassin); Fort Sherman, Idaho, abundant September 15-20, 1896 (Merrill); Newcastle, Colo., October 5, 1902 (Bishop); Lincoln, Nebr., November 14, 1899 (Wolcott); Lanesboro, Minn., November 2, 1889 (Hvoslef); southern Iowa, average October 27, latest November 9, 1895 (Currier); Chicago, Ill., average October 11, latest October 28, 1895 (Blackwelder); English Lake, Ind., November 9, 1891, November 15, 1892 (Butler); Ottawa, Ontario, October 31, 1906 (White); city of Quebec, Canada, November 10, 1890 (Dionne); San José, Costa Rica, December 15, 1890 (Cherrie).

The golden plover is one of the shorebirds that has diminished most markedly during the last twenty years. Formerly it was enormously abundant, and many are the accounts of the countless flocks that passed in an almost continuous stream across the Gulf of



KILLDEER (*OXYECHUS VOCIFERUS*).



St. Lawrence and out to sea. On the return up the Mississippi Valley also they were abundant. For the ten years 1895-1904 the numbers reported have been so small that the species seemed in imminent danger of extinction. During 1905 and 1906, however, the species was reported from quite a number of localities, indicating that at present the comparatively small number of individuals left are holding their own. The future of the American golden plover is in the hands of the sportsmen of the Mississippi Valley. During the breeding season the birds are out of reach of danger from mankind; through the winter their welfare is out of the control of the people of the United States; but in spring during their two thousand mile journey up the Mississippi Valley, for from six to eight weeks, great numbers are slaughtered, and as a result they have diminished to a small fraction of their former numbers. If the species is to hold its own spring shooting in the Mississippi Valley must be largely curtailed or entirely abolished.

**Pacific Golden Plover.** *Charadrius dominicus fulvus* Gmel.

The principal summer home of the Pacific golden plover is in Asia, where it breeds in northern Siberia east of the Yenisei River; it breeds also on the western coast of Alaska from near Bering Strait south to Bristol Bay. It winters on the Hawaiian Islands and in China and India and south to New Zealand and Australia. Early dates of arrival in Alaska are at Portage Bay, May 13, 1882 (Hartlaub); Kadiak Island, May 13, 1868 (Bischoff); Atka Island, May 17, 1879 (Turner). The usual time of arrival at the mouth of the Yukon is about the first of June, and the latest date in the fall is October 12 (Nelson).

**Killdeer.** *Oxyechus vociferus* (Linn.).

**Breeding range.**—The killdeer has one of the most extensive breeding ranges of the American shorebirds. It ranges north in summer to central Quebec (Merriam), northern Ontario (Todd), central Keewatin (Preble), southern Mackenzie (Preble), and to about latitude 53° in the interior of British Columbia. The killdeer was seen at Fort Churchill, Keewatin, and at Fort Resolution, Mackenzie, by parties of the Biological Survey, and these observations very materially extend its previously known northern range. The breeding range of the killdeer extends much farther south than that of other northern breeding shorebirds. The species breeds not only throughout the whole of the United States, but south to Cape St. Lucas, Lower California (Xantus), and to Rio Sestin, Durango (Miller). Killdeers occur in Newfoundland in the fall (Reeks), but are not known to breed on that island.

**Winter range.**—The winter range is much less extensive than the summer. Though there are records of the presence of the species in

Paraguay (Sharpe) and Chile (Salvin), it is probable that these represent casual occurrences and that regularly the species ranges to the Bermudas (Jardine), throughout the West Indies and the neighboring northern coast of Venezuela (Ernst), but not farther east or south on the Atlantic coast; while on the Pacific it regularly passes south to northwestern Peru (Sclater and Salvin) and the interior of Colombia and Medellin (Sclater and Salvin). The northern winter range extends regularly to North Carolina (Brimley), Tennessee (Gettys), central Texas (Brown), rarely southern Arizona (Mearns), and throughout most of the southern half of California (Fisher). Casual occurrences have been noted in Maryland (Stabler), Pennsylvania (Burns), and Rhode Island (Mearns). After the great storm of November, 1888, which carried large numbers of killdeer to the New England coast several weeks later than the usual time for their disappearance from that part of their range, many of these birds failed to undertake a second southward migration and remained on the coasts of Massachusetts (Torrey), New Hampshire (Chadbourne), and southwestern Maine (Brown). Most of them perished during the winter, but on the Massachusetts coast a few managed to endure. An occasional killdeer passes a mild winter in southern Ohio (Jones), southern Indiana (McAtee), or on the Pacific coast to Washington (Johnson).

*Spring migration.*—The killdeer is among the earliest migrants among shorebirds, and is not far behind the earliest migrating land birds. Its loud, piercing, oft-repeated calls make its identification easy, and many data have been accumulated concerning the time of its migrations. These begin in February in the northern part of the winter range, and during that month many crowd northward to the limit of unfrozen ground. Such birds arrive on the average near Asheville, N. C., February 22, earliest February 18, 1893 (Cairns); central Kentucky, February 25, earliest February 19, 1906 (Embody); Brookville, Ind., February 23, earliest February 15, 1890 (Butler). The early days of March find the killdeer in full migration far beyond its winter home, and its arrival has been noted as follows: Variety Mills, Va., average March 13, earliest March 2, 1888 (Micklem); White Sulphur Springs, W. Va., average March 9, earliest March 2 1891 (Surber); Washington, D. C., average March 18, earliest February 14, 1908 (Hollister); Waynesburg, Pa., average March 8, earliest February 24, 1891 (Jacobs); Berwyn, Pa., average March 14, earliest January 29, 1889 (Burns); Branchport, N. Y., average March 19, earliest March 1, 1890 (Burtch); Jewett City, Conn., average for twenty-one years March 17, earliest March 2, 1888 (Jennings); central Rhode Island, average March 19, earliest February 27, 1902. Even as far north as Rhode Island, the killdeer is so rare that a market gunner near Newport (Sturtevant) secured only three during eight years while shooting several thousand shorebirds.

There seems to be a section west of the Allegheny Mountains in which the killdeer arrives earlier than at corresponding latitudes either east or west. The average date of arrival at Waterloo, Ind., is March 5 (Link); Oberlin, Ohio, March 5 (Jones); Livonia, Mich., March 10 (Alexander); and Petersburg, Mich., March 10 (Trombly). Near there in Pennsylvania, on the western side of the mountains, the date of arrival at Waynesburg has already been given as March 8 (Jacobs). At the same latitude in Pennsylvania east of the mountains the killdeer arrives a week later, while to the westward of Indiana the retardation of migration is shown by the following dates of arrival: Central Missouri, average March 12, earliest February 4, 1890 (Bush); southern Iowa, average March 12, earliest March 2, 1906 (Davison); southern Wisconsin, average of thirty years March 15, earliest March 2, 1887 (Welman); Chicago, Ill., average of sixteen years March 21, earliest February 28, 1895 (Woodruff). Farther north in Ontario, as the killdeer nears the limit of its breeding range, the arrival is much delayed; southern Ontario is not reached on the average until March 23, earliest March 7, 1903 (Smith), while the average date at Ottawa, Ontario, is April 17, earliest March 18, 1894 (White). Dates of arrival farther west are: Manhattan, Kans., average March 8, earliest February 27, 1882 (Lantz); Onaga, Kans., average March 4, earliest February 23, 1891 (Crevecoeur); Syracuse, Nebr., average March 10, earliest February 26, 1902 (Hunter); central South Dakota, average March 24, earliest March 20, 1889 (Cheney); Lanesboro, Minn., average March 29, earliest March 13, 1889 (Hvoslef); Argusville, N. Dak., average April 7, earliest March 31, 1893 (Edwards); Larimore, N. Dak., average April 7, earliest April 3, 1893 (Eastgate); southern Manitoba, average April 5, earliest March 24, 1902 (Criddle); Qu'Appelle, Saskatchewan, average April 16, earliest April 8, 1903 (Wemyss); two seen June 25, 1903, at Fort Resolution, Mackenzie (Preble).

The advance in the Rocky Mountains is not so late comparatively as in most species: Cheyenne, Wyo., average March 21, earliest March 16, 1889 (Bond); Rathdrum, Idaho, average March 30, earliest February 19, 1902 (Danby); Terry, Mont., average April 6, earliest March 29, 1897 (Cameron); Big Sandy, Mont., average April 6, earliest April 3, 1904 (Coubeaux); Red Deer, Alberta, April 11, 1893 (Farley); Portland, Oreg., February 27, 1900 (Nicholas); Grays Harbor, Washington, February 16, 1892 (Lawrence); southern British Columbia, February 28, 1888 (Brooks). South of the breeding grounds the last was seen at San José, Costa Rica, March 12, 1890 (Cherrie), and at Sisal, Yucatan, May 9, 1865 (Schott).

The date of nesting seems to bear little relation to the latitude. Eggs have been taken at Cape St. Lucas, Lower California, May 9, 1860 (Xantus); Monterey, Calif., March, 1867 (Day and Spencer);

Variety Mills, Va., April 12, 1886 (Micklem); Laurel, Md., just hatching April 24, 1897; Erie, Pa., April 7, 1888 (Todd); Canandaigua, N. Y., April 23, 1879 (Howey); Bloomington, Ind., April 12, 1903 (McAtee); Kingston, Ontario, May 1, 1905 (Beaupre); Eagle Pass, Tex., March 18, 1884 (Negley); Corvallis, Oreg., downy young late April (Woodcock); Tacoma, Wash., April 14, 1908 (Bowles); Edmonton, Alberta, eggs May 19, 1897 (Macoun).

*Fall migration.*—The few records of fall arrival south of the breeding range show that the killdeer is one of the late migrants. It was noted in Porto Rico, October 18, 1899, and October 7, 1900 (Bowdish); San José, Costa Rica, October 15, 1891 (Cherrie); and on the coast of Peru, October 24, 1867 (Sclater and Salvin).

The last noted in southern British Columbia was November 28, 1888 (Brooks); Aweme, Manitoba, average September 23, latest September 30, 1901 (Criddle); Onaga, Kans., average October 22, latest November 8, 1896 (Crevecoeur); Lincoln, Nebr., latest November 18, 1900 (Wolcott); Delavan, Wis., November 6, 1894 (Hollister); southern Iowa, average November 10, latest December 25, 1886 (Houghton); Chicago, Ill., average October 21, latest November 13, 1885 (Holmes); southern Michigan, average November 1, latest November 13, 1891 (Alexander); Ottawa, Ontario, average September 11, latest October 16, 1905 (White); southern Ontario, average October 19, latest November 10, 1900 (Saunders); Wauseon, Ohio, average November 9, latest November 23, 1891 (Mikesel); Waterloo, Ind., average November 7, latest November 21, 1905 (Link); Montreal, Canada, September 1, 1895 (Wintle); Phillips, Me., October 24, 1905 (Sweet); Block Island, R. I., November 5, 1889 (Dodge); Branchport, N. Y., November 29, 1896 (Stone); Suffield, Conn., November 16, 1887 (Smith); Erie, Pa., November 26, 1891 (Todd); Berwyn, Pa., average November 3, latest November 22, 1886 (Burns); Bloomington, Ind., December 12, 1885 (McAtee); St. Louis, Mo., December 18, 1887 (Widmann).

[**Santo Domingo Killdeer.** *Oxyechus vociferus torquatus* (Linn.).

The Santo Domingo killdeer is the resident form of the West Indies, breeding in Cuba, the Isle of Pines, Jamaica, and Haiti, and probably also in Porto Rico.]

[**Semipalmated Plover.** *Egialitis semipalmata* (Bonap.).

*Breeding range.*—The present known summer home of the semipalmated plover extends north to Cumberland Sound (Kumlien), Melville Peninsula (Parry), Wellington Channel (Greely), and Melville Island (Parry). The occurrence of the species at these two latter places, latitude about 75° N., makes it probable that it occurs equally far north on the western side of Baffin Bay. It is common on the arctic coast of America as far west as the mouth of the Mackenzie (MacFarlane). Thence westward it seems to be rare on the northern coast of Alaska (Nelson), but is tolerably common in Kotzebue

Sound (Townsend). It seems to be more common in the middle Yukon Valley (Bishop) than on the coast.

This plover breeds south to Sable Island (Dodd); southern New Brunswick (Cheney); the Magdalen Islands (Brewster); southern James Bay (Todd); York Factory, in southern Keewatin (Preble); probably rarely in northern Manitoba (Macoun); on the Slave River of southern Mackenzie (Preble); Lake Marsh, southern Yukon (Bishop); and to the mouth of the Yukon, Alaska (Dall and Bannister).

*Winter range.*—The species winters on both coasts of South America—south to Port Desire, 48° S. (Seeböhm), on the east coast, and to central Chile (Schalow) on the west; thence through northern South America, Central America, and the West Indies to the southern Bahamas (Bonhote), Florida (Worthington), the coast of Georgia (Helme), South Carolina (Kendall), Mississippi (Allison), and Louisiana (Beyer); on the Pacific coast of Mexico, north to southern Lower California (Brewster). In winter it is thus one of the most widely distributed of the shorebirds.

*Migration range.*—The species is a common migrant in eastern North America west to the eastern parts of Texas (Beckham), Nebraska (Wolcott), and Saskatchewan (Macoun). Thence over the plains and throughout the whole Rocky Mountain district it is almost unknown, but reappears on the Pacific Coast, and ranges west in migration to the central Aleutian Islands (McGregor), the Pribilof Islands (Prentiss), and even occasionally across Bering Strait to the coast of Siberia (Nelson).

*Spring migration.*—At least four-fifths of the dates on the spring migration of this species fall in May. This is true for the entire district between the winter and summer homes, and the dates indicate that the migration in the United States occurs chiefly between May 10 and June 1. An unusually early individual was taken April 7, 1875, at Erie, Pa. (Sennett). Other spring dates are: Magdalena Bay, Lower California, March 12, 1889 (Bryant); Monterey, Calif., April 17, 1903; Vancouver Island, British Columbia, April 28, 1894 (Kermode); Mount McKinley, Alaska, May 17, 1908 (Sheldon); Kowak River, Alaska, May 30, 1899 (Grinnell); Pea and Bodie islands, North Carolina, April 25, 1905 (Bishop); Lincoln, Nebr., April 27, 1900 (Wolcott); southern Ontario, average of six years May 18, earliest May 8, 1885 (Garnier); Melville Peninsula, May 31, 1882 (Parry); Wellington Channel, June 6, 1851 (Greely). The species was taken in Cuba as late as May 22, 1900 (Palmer and Riley); southern Florida, May 25, 1886 (Scott); from New Jersey to the Great Lakes it remains regularly to the first week in June—latest Oberlin, Ohio, June 17, 1904 (Jones); latest Worth, Ill., June 20, 1894 (Woodruff); and along the coast of Maine nonbreeders occur all summer (Knight).

Eggs have been taken at Grand Manan, New Brunswick, June 21, 1875 (Cheney); James Bay, June 18, 1896 (Macoun); Cape Fullerton, June 28, 1904 (Eifrig); Fort Anderson, June 11, 1863 (MacFarlane); Fort Yukon, Alaska, June 2, 1862 (Lockhart); Lake Marsh, Yukon, just hatched, July 2, 1899 (Bishop).

*Fall migration.*—At one of the most southern breeding places, near York Factory, Keewatin, in 1900, the most advanced young were still in the downy stage July 10 (Preble), and yet by this time the species is already in full fall migration, and the earliest individuals have appeared several hundred miles south of the breeding range: Toronto, Ontario, July 5, 1890 (Fleming); Rhode Island, July 6 (Howe and Sturtevant); Coronado de Terraba, Costa Rica, July 3, 1907 (Carriker); Margarita Island, off the coast of Venezuela, July 7, 1895 (Robinson). The regular fall migration is about a month later: Sitka, Alaska, common after July 25, 1896 (Grinnell); Prince Edward Island, average of three years August 13 (Bain); Long Island, New York, average of seven years August 6, earliest July 17, 1905 (Latham); Grenada, West Indies, August 24, 1881 (Wells); Santa Catarina, Brazil, August 4 (Sharpe).

Though most semipalmated plover migrate early, a few stay until freezing weather: Ottawa, Ontario, average of five years September 19, latest September 29, 1885 (White); Prince of Wales Sound, Ungava, latest September 25, 1886 (Payne); Prince Edward Island, average of three years, October 13 (Bain); Erie, Pa., rare after October 1, latest November 2, 1901 (Todd); Point Pelee, Ontario, October 29, 1905 (Taverner and Swales); Grinnell, Iowa, October 22, 1886 (Jones); Los Angeles County, Calif., October 17, 1894 (Grinnell).

**Ringed Plover.** *Agialitis hiaticula* (Linn.).

Both coasts of Greenland are included in the breeding range of the ringed plover, from the southern end to Sabine Island (Scoresby) on the east coast and to McCormick Bay (Schalow) on the west. Across Smith Sound from this latter place and one degree farther north, at Buchanan Bay, Ellesmere Island, latitude 78° 48' (Feilden) is the farthest north the species has been found in the Western Hemisphere, though north of Europe it has been taken at 83° latitude. On the American side it breeds south to Cumberland Sound (Kumlien); also south to central Europe and Turkestan, and east to the New Siberian Islands, and occurs casually east to the Chuckchi Peninsula. The winter is spent from the shores of the Mediterranean to southern Africa and rarely to northwestern India. It has wandered to Chile (Sharpe), and to Barbados, September 10, 1888 (Feilden). The first arrived at Cumberland Sound in 1878 about the middle of June (Kumlien).

**Little Ringed Plover.** *Agialitis dubia* (Scop.).

The claim of the little ringed plover to a place among North American birds is rather slight. A specimen is supposed to have been taken on

the coast of Alaska (Harting), and one is recorded from San Francisco, Calif. (Ridgway). In each case the bird was far from home, for the breeding grounds of the species are in southern Europe, central Asia, and north to about 60° latitude. The species winters in the northern half of Africa, and in Asia south to India, and the Malay Archipelago.

**Piping Plover.** *Ægialitis meloda* (Ord).

**Breeding range.**—The northern limit of the piping plover's breeding range is in Nova Scotia (Bryant), the Magdalen Islands in the Gulf of St. Lawrence (Bishop), southern Ontario (Saunders), central Manitoba (Bendire), southern Saskatchewan (Macoun), and probably southwestern Keewatin (King). It is very local in its distribution during the breeding season, and is unknown over most of the district mentioned above. Formerly it nested on the coast of Virginia at Cobbs Island (Kirkwood), and was fairly common as a breeder on the New Jersey coast (Scott). Now it is rare as a breeder anywhere on the Atlantic coast south of Nova Scotia, though still nesting at a few localities south to southern New Jersey (Stone). In the interior it nests as far south as Erie, Pa. (Todd); the lake shore in northern Ohio (Jones); near Lake Michigan in northwestern Indiana (Woodruff); and west to central Nebraska (Bruner, Wolcott, and Swenk).

**Winter range.**—The coast of Texas (Sennett) and the coasts of Florida (Scott) and Georgia (Worthington) constitute the principal winter home of this species. Indeed, it is probable that records at other places represent stragglers. The West Indies are commonly included in the winter range, but the species seems to be only casual in migration south of the United States. It was taken once in Porto Rico in August (Gundlach); Jamaica in November (Gosse); a few in Cuba in April of a single year (Gundlach); several on three islands of the Bahamas in May (Bangs) and July (Bonhite); three individuals in the Bermudas in the fall (Reid). It has occurred occasionally on the New Jersey coast in winter (Stone).

**Spring migration.**—Dates of spring arrival are very irregular. The average date on Long Island, New York, is April 7; earliest March 24, 1884 (Dutcher); eastern Massachusetts, average April 12, earliest March 26, 1893 (Mackay); southern Ontario, average May 16, earliest May 1, 1891 (Fleming). Some other dates of arrival are: Cumberland, Ga., March 10, 1902 (Helme); near Newport, R. I., March 24, 1903 (King); Erie, Pa., April 16, 1900 (Todd); Oberlin, Ohio, May 13, 1907 (Jones); Sioux City, Iowa, May 8, 1904 (Rich); Gibbon, Nebr., May 4, 1888 (Thatcher); Indian Head, Saskatchewan, May 16, 1892 (Macoun). Thus, in general, migration up the Mississippi Valley is much later than at corresponding latitudes on the

Atlantic coast. Stragglers were noted at Cheyenne, Wyo., May 30, 1892 (Bond), Julesburg, Colo., May 17, 1899 (Dawson), and Natashquan, Labrador, May 31, 1909 (Townsend and Bent).

Eggs have been taken at Big Charity Island, Michigan, May 20, 1903 (Arnold); Erie, Pa., May 24, 1900 (Todd); Long Beach, New Jersey, June 12, 1877 (Scott); Magdalen Island, June 16, 1897; Cedar Point, Ohio, June 26, 1903 (Jones); Miller, Ind., June 13, 1905 (Butler); Miner County, S. Dak., June 5, 1891 (Patton); near Indian Head, Saskatchewan, June 18, 1892 (Macoun). Downy young were taken July 21, 1906, at Big Stick Lake, southwestern Saskatchewan (Bent).

*Fall migration.*—The first was seen on the coast of North Carolina July 14, 1904 (Bishop); and at Fernandina, Fla., August 3, 1906 (Worthington). It was taken at Corpus Christi, Tex., all through July, 1887 (Sennett), but these may have been nonbreeders that summered on the coast. In general the species migrates so early that it is seldom found north of its winter home after August. Late dates are: Long Island, New York, August 30, 1889 (Scott); eastern Massachusetts, August 26, 1888 (Miller); Erie, Pa., September 26, 1902 (Todd).

**Snowy Plover.** *Ægialitis nivos*a Cass.

*Breeding range.*—The sea coasts and the shores of the larger lakes of western United States constitute the principal breeding grounds of the snowy plover. The species nests at least as far north as Pescadero, Calif. (Willard); Humboldt River, Nevada (Hanna); Salt Lake, Utah (Ridgway); Comanche County, Kans. (Goss); and on the coast of Texas (Sennett). It is extremely local in the interior. It breeds south at least to Corpus Christi, Tex. (Sennett), and probably along the northern third of the western coast of Lower California (Belding).

*Winter range.*—It winters in Chile south at least to Calbuco, latitude 41° S. (Schalow), and thence north in Peru (Sclater and Salvin), Guatemala (Salvin), and Mexico (Belding) to the coast of California at Santa Barbara (Keck). On the Atlantic side it winters as far north as Aransas Bay, Texas (Sennett).

*Migration range.*—Outside of the regular winter and summer homes, the species has been taken once in Brazil (specimen in United States National Museum); Margarita Island, off the coast of Venezuela, July 2, 1895 (Robinson); Guantanamo, Cuba, July, 1858 (Gundlach); Long Island, Bahamas, July 16, 1903 (Riley); Celestun, Yucatan, April 12, 1865 (Schott); Whitfield, Fla., May 5, 1903 (Worthington); Bay St. Louis, Miss., September 19–20, 1899 (Allison); Toronto, Ontario, twice (Fleming); Lincoln, Nebr., May 17, 1903 (Swenk); Cheyenne, Wyo., once (Bond); Newport, Oreg., March 24, 1906 (Shaw); Grays Harbor, Washington, September 3, 1899 (Dawson).

*Spring migration.*—The snowy plover was seen in Comanche County, Kans., May 12, 1887 (Goss), and at San Francisco, Calif.,

April 8, 1857 (Hepburn). The species has been taken at Cavanche, Chile, in May (Schalow), and at Coquimbo, Chile, in June (Sharpe). It may prove to be resident in Chile.

Eggs have been taken in Los Angeles County, Calif., April 25, 1899 (Robertson), and young, May 1, 1897 (Grinnell); also eggs at Santa Cruz, Calif., April 16, 1873 (Cooper). In southern Kansas the eggs are laid in late May (Goss).

*Fall migration.*—Fall migrants have been recorded in September from Guatemala (Salvin), and in October from the southern limit of the range in Chile (Schalow). The species has been taken at San Francisco as late as November 1, 1898 (Hornung).

**Mongolian Plover.** *Ægialitis mongola* (Pall.).

In the summer of 1849 Captain Moore of the *Plover* in his search for Sir John Franklin touched at the Choris Peninsula, Alaska, and while there secured two specimens of the Mongolian plover—the first and only individuals ever taken in North America. The breeding range of the species is on the opposite side of Bering Sea, on the Commander Islands, and in northeastern Siberia. It migrates through Japan and China, and winters from the Philippines to Australia.

**Azara Ring Plover.** *Ægialitis collaris* (Vieill.).

The Azara ring plover is the only true shorebird found in Central America that does not range north to the United States. It has a wide distribution in South America, south to Argentina, extends north to southern Mexico, and has been taken once on Grenada, West Indies.]

**Wilson Plover.** *Ochthodromus wilsonius* (Ord).

*Breeding range.*—The Wilson plover is found in summer throughout the northern Bahamas (Bonhote) and along the Gulf coast of the United States from Florida (Scott) to Texas (Merrill), and breeds along the Atlantic coast at the present time as far north as the islands off the southeastern coast of Virginia (Dutcher); many years ago it bred occasionally on the New Jersey coast (Wilson). The summer status of the species on the Pacific coast of Lower California is not yet definitely settled. It was found common at Abreojos Point, June 17, 1897 (Kaeding), but whether or not it was breeding was not determined.

*Winter range.*—The winter range is not known with certainty, because the West Indies are occupied by a resident subspecies, *rufinuchus*, and sufficient material has not yet been accumulated to determine the relative areas occupied by the two forms in winter. The northern form winters as far north as southern Florida—formerly northern Florida (Scott); the coast of southern Texas (Merrill); Guaymas, Sonora (Nelson); and La Paz, Lower California (Belding). Thence it ranges south to the Pacific coast of Guatemala (Salvin).

*Spring migration.*—Dates of arrival on the Atlantic coast are: Amelia Island, Florida, April 2, 1906 (Worthington); Darien, Ga.,

March 19, 1890 (Worthington); Cumberland Island, Georgia, March 18, 1902 (Helme); Frogmore, S. C., March 26, 1886, and March 20, 1888 (Hoxie); Fort Macon, N. C., April 15, 1869 (Coues). The species has wandered north on the coast several times to Long Island (Dutcher), once to Connecticut (Purdie), once to Massachusetts (Coues), and even to Nova Scotia (Goss). The only record for the Pacific coast of the United States is that of the single bird taken June 29, 1894, at Pacific Beach, California (Ingersoll).

Eggs have been taken at Sarasota Bay, Florida, April 8 (Moore); coast of Georgia, April 29 (Bailey); Corpus Christi, Tex., April 25 (Chapman); Cobbs Island, Virginia, May 7 (Oates).

[**Rufous-naped Plover.** *Ochthodromus wilsonius rufinuchus* (Ridgw.).

The principal home of the subspecies rufous-naped plover is the Greater Antilles, whence it spreads to the neighboring coasts of British Honduras and Guatemala; probably also to Yucatan. It breeds also in northern South America on the coast of Colombia, Venezuela, and Guiana. While some individuals remain all the year on the breeding grounds, others migrate a short distance to several of the islands of the Lesser Antilles and to Brazil as far south as Bahia. It is probably this form that occurs on the coast of Ecuador and Peru, but from lack of specimens this point is not settled.]

[**Mountain Plover.** *Podasocys montanus* (Townsend).]

**Breeding range.**—The mountain plover seems to be confined in summer to the United States, but closely approaches the boundaries, both north and south. In 1874 it was found breeding and not uncommon on the Frenchman River in Montana (Coues), not far from the Canadian boundary, and on Milk River, Montana (Coues), right at the line, but so far has not been recorded anywhere in Canada. It breeds south to northern New Mexico (Henshaw); east to northwestern Texas (Bailey), western Kansas (Fisher), and western Nebraska (Bruner), west to Sun River, Montana (Dutcher), Fort Bridger, Wyo. (Drexler), Del Norte, Colo. (Hill and Orth), and San Miguel County, New Mexico (Mitchell).

**Winter range.**—This species winters from northern California (Cooper), southern Arizona (Osgood), and San Antonio, Tex. (Beckham), south to Zacatecas, Mexico (Sharpe), and La Paz, Lower California (Sharpe). It is one of the few species that winters farther west than it breeds.

**Migration range.**—The more eastern individuals of this species probably follow the usual north and south migration route, keeping to the plains east of the foothills of the Rocky Mountains, but some of the more western individuals take a very peculiar course in migration. The species is a tolerably common migrant at Marysville in northern California (Belding), arriving in November. Whence come these November birds? The nearest point of the breeding range is northwestern Montana in the vicinity of Great Falls (Williams). To reach Marysville from Great Falls the plover must pass through

Idaho and either Oregon or Nevada, but in these three States it is unknown, and seems not to be recorded from Utah. So the birds that visit California are separated from the nearest known habitat of the species by a zone about 600 miles wide and containing two ranges of high mountains.

*Spring migration.*—The mountain plover is among the early migrant shorebirds. It arrived on the average at Beloit, Colo., March 26, earliest March 23, 1890 (Hoskins); Loveland, Colo., March 18, 1887 (Smith).

Eggs have been taken at Fort Lyon, Colo., June 9, 1886 (Thorne); San Luis Valley, Colo., June 10, 1873 (Henshaw); young just hatched at Terry, Mont., June 15, 1898 (Cameron); young at Colby, Kans., June 28, 1893 (Fisher); eggs near North Platte, Nebr., July 8, 1859 (Suckley).

*Fall migration.*—The first was seen at Corpus Christi, Tex., July 25, 1887 (Sennett); Pecos City, Tex., August 1, 1903 (Ligon). Quite a party of them was seen at James Island, Florida, July 20 to August 1, 1901 (Williams), but they were probably only stragglers. The last one noted in 1890 at Beloit, Colo., was on October 15 (Hoskins).

**Surf Bird.** *Aphriza virgata* (Gmel.).

The breeding range of the surf bird is unknown, for the bird has never been encountered in its summer home. It goes north along the Pacific coast of the United States in spring, and has been traced all along the coast to the Kowak River, Alaska, where it arrived May 29, 1899 (Grinnell). Then it disappears and is not seen again until on its way south the latter part of July. The natives say it breeds on the mountains a few miles back from the coast.

The surf bird winters in Chile, as far south as the Strait of Magellan (Sharpe), and is known in migration on the coasts of Peru (Tschudi), Ecuador (Hartert), Mexico (Xantus), and Lower California (Kaeding). It arrived at Newport, Oreg., April 25, 1895; April 27, 1897; May 3, 1899; April 27, 1900; average of the four years April 28 (Bretherton). Agreeing well with this date is its appearance at San Geronimo Island, Lower California, March 15, 1897 (Kaeding); and the date already given of May 29 at Kowak River, Alaska (Grinnell). An extra early date is March 8, 1859, at Puget Sound, Washington (Kennerly). The latest recorded date at the Strait of Magellan is March 3, 1879 (Sharpe); the species was common at Abreojos Point, Lower California, April 19, 1897 (Kaeding); a belated bird was taken on the Farallon Islands, Calif., June 3, 1903 (Kaeding). Several appeared in fall migration at Sitka, Alaska, July 21 (Grinnell); Newport, Oreg., July 24, 1900 (Bretherton); Monterey Bay, Calif., August 3, 1894 (Loomis); Vaqueria, Ecuador, September 16, 1901 (Hartert). The species has been noted at St. Michael, Alaska, until the first of October (Nelson), and at Berkeley, Calif., as late as October 24, 1888 (Palmer).

**Turnstone.** *Arenaria interpres* (Linn.).

*Breeding range.*—The turnstone inhabits nearly the whole of the Eastern Hemisphere and a small part of the Western. It breeds along the whole Arctic coast of Europe and Asia and south to Japan and the islands in the Baltic Sea. It ranges eastward across Bering Strait at least to Point Barrow, Alaska (Stone), and breeds south to the mouth of the Yukon (Nelson) and on the islands of St. Lawrence (Nelson) and St. Matthew (Elliott) in Bering Sea. Its range to the northeastward in North America has not yet been definitely settled. Two specimens from the west coast of central Greenland have been identified by W. Palmer as *interpres*. No specimens were examined by him from any point between Greenland and the Anderson River, Mackenzie; the specimens from this latter place are certainly *morinella*. Where the dividing line between the two forms runs is not certain, but since the birds of eastern Ungava are *morinella*, it is probable that this is the form occurring on the islands near the Arctic coast of North America and equally probable that the records on the islands northwest of Greenland should be referred to *interpres*. The species has been recorded along the whole west coast of Greenland, and was found breeding at Disco Bay (Kumlien) and on the eastern and northern coasts of Ellesmere Island almost to latitude 83° (Feilden). The turnstone, therefore, is one of the most northern breeding of all birds. On the eastern coast of Greenland it ranges at least as far north as Sabine Island, latitude 74° (Winge).

*Winter range.*—The species winters on the coasts of nearly the whole of the Eastern Hemisphere from Europe and Asia to southern Africa, Australia, and the islands of the Pacific, Indian, and eastern Atlantic oceans.

*Spring migration.*—The species arrived in the Aleutians at Unalaska May 19, 1890 (Palmer). As it winters in Hawaii (Henshaw), and is not known on the coast of the mainland south of Alaska, it is practically certain that these Unalaska birds make the journey of 2,000 miles in a single flight from Hawaii to the Aleutians. Other dates of spring arrival are: Mouth of the Yukon, May 19, 1879 (Nelson); Nulato, Alaska, May 23, 1868 (Dall); Point Barrow, Alaska, June 12, 1882 (Murdoch), June 12, 1883 (Murdoch), and May 29, 1898 (Stone). The dates of arrival northwest of Greenland are May 27, 1876, at Cape Henry (Hart), and June 2, 1883, at Cape Baird (Greely), each near latitude 82°.

Eggs were taken July 30, 1876, at Discovery Bay, Ellesmere Island, 81° 40' N. (Hart), and young were already on the wing July 9, 1883, at Fort Conger (Greely), a few miles distant. Downy young were taken June 4, 1898, at Point Barrow, Alaska (Stone).

*Fall migration.*—The first arrived on the Pribilof Islands July 2 (Elliott), and after the middle of the month were abundant. The

last ones noted were: Depot Point, Ellesmere Island, latitude 82° 45' N., September 11, 1875 (Feilden); Point Barrow, Alaska, August 29, 1882 (Murdoch), and September 4, 1897 (Stone); Nushagak, Alaska, September 21, 1902 (Osgood). A specimen is reported taken September 8, 1904, at Pacific Beach, Calif. (Bishop), and one September 8, 1892, on Monomoy Island, Massachusetts (Bishop).

**Ruddy Turnstone.** *Arenaria interpres morinella* (Linn.).

**Breeding range.**—Undoubted breeding records of the ruddy turnstone are very rare. It nested on the Lower Anderson and Franklin Bay (MacFarlane), and specimens of the breeding birds have been identified as *morinella*. Some form of the turnstone, probably *morinella*, breeds on Melville Island (Sabine), on Melville Peninsula (Parry), and at Bellot Strait (Walker), but its identity has yet to be determined by the examination of specimens.

**Winter range.**—The turnstone of the Western Hemisphere ranges south in winter to central Chile—at least to Talcahuano (Sharpe) and probably to Valdivia (Boeck)—and to Sao Paulo in Brazil (Ihering). It winters on the coasts of northern South America, in the West Indies, Central America, Mexico, and north to the coast of South Carolina (Coues), Louisiana (Beyer), Texas (Merrill), and in California at least as far north as San Francisco (Mailliard).

**Spring migration.**—The turnstone, notwithstanding it winters so far north, is a late migrant. The probable explanation is that its breeding grounds in the far north are not ready for occupancy until nearly midsummer. It was seen May 7, 1906, on Pea and Bodie islands, North Carolina (Bishop). The average date of arrival on Long Island, New York, is May 16, earliest May 12, 1897 (Scott); eastern Massachusetts, May 5, earliest May 1, 1892 (Mackay); Erie, Pa., May 24, 1893 (Todd). It appears to be rare in spring north of Maine on the Atlantic coast.

The species is rare in the interior of the United States, but has been noted a few times in nearly every State east of the Rocky Mountains. Some dates of arrival are: Starke County, Ind., May 20, 1888 (Butler); Oberlin, Ohio, May 16, 1901 (Jones); southern Ontario, average May 27, earliest May 24, 1900 (Nash); Leech Lake, Minn., May 24, 1903 (Currier); Indian Head, Saskatchewan, May 15, 1892 (Macoun); Fort Chipewyan, Alberta, May 25, 1901 (Preble); Fort Resolution, Mackenzie, June 1, 1860 (Kennicott); Fort Simpson, Mackenzie, May 29, 1904 (Preble); Fort Anderson, Mackenzie, June 10, 1864 (MacFarlane); Winter Island, Melville Peninsula, June 14, 1822 (Richardson).

It was found off the coast of Venezuela, July 2, 1892 (Hartert), July 7, 1895 (Robinson), and early July, 1901 (Clark). A few are said to remain all summer on Carriacou Island, West Indies (Wells).

The migrant birds remain in numbers far south of the breeding grounds until early June: Jamaica, June 12, 1863 (Field); Arcos Keys, Yucatan, June 6, 1900 (Nelson and Goldman); Key West, Fla., June 14, 1888 (Scott); Long Island, New York, average June 4, latest June 9, 1905 (Latham); Toronto, Ontario, June 17, 1894 (Fleming).

*Fall migration.*—The southward movement must begin in July, for by early August migrants have appeared over much of the coasts of the United States. Some dates of fall arrival are: Monomoy Island, Massachusetts, July 27, 1886 (Cahoon); Long Island, New York, average August 5, earliest July 27, 1892 (Scott); Monterey, Calif., July 18, 1892 (Loomis); Fort Churchill, Keewatin, July 30, 1900 (Preble); common at Corpus Christi, Tex., after July 1, 1887 (Sennett); Toronto, Ontario, July 30, 1898 (Nash); Henley Harbor, Ungava, August 20, 1860 (Coues); Mingan Island, Gulf of St. Lawrence, August 16, 1887 (Palmer); Montreal, Canada, August 17, 1891 (Wintle); Erie, Pa., August 24, 1889 (Sennett); Punta Rassa, Fla., August 2, 1886 (Scott); San Mateo, Tehuantepec, August 9, 1869 (Sumichrast); Jamaica, August 13, 1863 (March); Bermudas, August 3, 1874 (Reid); Talcahuano, Chile, September 9, 1879 (Sharpe). Dates of the last seen are: York Factory, August 26, 1900 (Preble); eastern Massachusetts, October 9, 1889 (Miller); Erie, Pa., September 25, 1900 (Todd); Long Island, New York, September 20, 1889 (Scott), accidental November 24, 1887 (Scott).

**Black Turnstone.** *Arenaria melanocephala* (Vig.).

*Breeding range.*—The black turnstone breeds commonly on the coast of Alaska near the mouth of the Yukon (Nelson) and up the Yukon as far as Nulato (Dall and Bannister). It breeds less commonly north to Kotzebue Sound (Townsend) and south to Nushagak (McKay). It has been seen on the eastern side of Bering Strait nearly to Point Barrow, Alaska (Nelson), and on the western side to Herald Island (Nelson), off the northern coast of Siberia, but it is not yet known to breed in either of these localities.

*Winter range.*—The greater number winter on the coast of Lower California, south to Magdalena Bay (Anthony). The species is not rare in winter on the California coast as far north as San Francisco (Mailliard), and a few have been known to winter at the Strait of Juan de Fuca (Suckley). It may winter occasionally even in south-eastern Alaska, for the National Museum has a specimen collected February 2, 1897, at Howkan Island, Alaska (Cantwell).

*Spring migration.*—The species arrived at St. Michael, Alaska, about the middle of May (Nelson) and at Nulato, Alaska, May 16, 1867, and May 23, 1868 (Dall and Bannister).

*Fall migration.*—The black turnstone occurs on the Pacific coast from British Columbia (Kermode) to southern California throughout

the entire summer, but is not known to breed (Grinnell). The presence of these nonbreeding birds prevents accurate observations on the arrival of the first migrants from the north, but it seems probable that early in July some appear on the coast of central California, and the species was seen August 6, 1902, on the Coronados Islands, Lower California (Grinnell and Daggett). The last leave the delta of the Yukon about the middle of September (Nelson) and Nushagak, Alaska, September 22, 1902 (Osgood).

**European Oyster-catcher.** *Hematopus ostralegus* Linn.

The southwestern coast of Greenland has been visited several times by the European oyster-catcher, once as far north as Godthaab, latitude 64° (Winge). It is not certainly known to breed there, but its breeding range extends from Iceland and western Europe to Turkey and from southern Europe to the Arctic coast. It winters from central Europe to central Africa and to western India.

**Oyster-catcher.** *Hematopus palliatus* Temm.

The oyster-catcher ranges south to Santa Catharina, southern Brazil (Sharpe), and to Arauco in central Chile (Sharpe). It occurs throughout most of the West Indies and Central America and along both coasts of Mexico—on the west coast north to the Tres Marias (Nelson). On the Atlantic coast it is resident as far north as South Carolina (Coues), and formerly was common on the Virginia coast (Bailey), and bred at Great Egg Harbor, New Jersey (Wilson). There are a few records for the coast of Massachusetts (Brewer) and one at Grand Manan, New Brunswick (Boardman). At the present time it is rare or accidental north of Virginia, though a flock of about 20 was seen July 20, 1907, at Digby, Nova Scotia, by W. H. Osgood, of the Biological Survey. It is still resident on the coasts of Louisiana and Texas.

It breeds throughout most of its regular range and probably most individuals are nonmigratory. The few that migrate along the southern Atlantic coast perform their short migrations principally in March. Eggs were taken at Corpus Christi, Tex., in 1882, April 6 to 27 (Goss). Eggs are recorded in Florida from April 10 to May 6; and they have been collected on the islands of the Virginia coast from May 3 to July 12.

**Frazar Oyster-catcher.** *Hematopus frazari* Brewst.

The Frazar oyster-catcher is apparently nonmigratory, and is the common breeding bird of both coasts of southern Lower California, whence it ranges along the whole west coast of the peninsula and north to San Diego (Cooper), the coast of Ventura County (Evermann), and the Santa Barbara Islands (Cooper), casual on the coast of Sinaloa, Mexico (Nelson and Goldman). In the northern part of its range it is not so numerous as *bachmani*, whose range overlaps that of

*frazari* for about a thousand miles from Ventura County, Calif., to Abreojos Point, Lower California (Kaeding).

**Black Oyster-catcher.** *Hæmatopus bachmani* Aud.

The coast of western North America is the home of the black oyster-catcher, and it breeds locally throughout its range from Abreojos Point, Lower California (Kaeding), north to Prince William Sound, Alaska (Grinnell), and west to Attu Island (Turner) at the western end of the Aleutian chain. It winters from the coast of southern British Columbia (Fannin) southward. The short migration is performed during May, and the eggs are deposited at the northern end of the range from the middle to the latter part of June. This is also the time at which eggs are most commonly found at the extreme southern end of the summer home. Downy young were taken June 17, 1900, on Queen Charlotte Islands, British Columbia (Osgood).

**[Stone Curlew.** *Œdicnemus bistratus* (Wagler).

The stone curlew is somewhat generally distributed throughout the lower portions of Central America from Panama to southern Mexico, and also ranges into South America north of the Amazon. It is nonmigratory.]

**Mexican Jacana.** *Jacana spinosa* (Linn.).

The Mexican jacana was described originally from Cartagena, Colombia, and as that remains still the only record for the country, the ascription to this locality was probably an error. The species is known from Divala, Panama (Bangs), and thence north on the Pacific side to Mazatlan, Mexico (Lawrence), and on the Gulf side to the mouth of the Rio Grande (Merrill). It is recorded from Porto Rico (Gundlach), Haiti (Ritter), Jamaica (Denny), and Cuba (Vigors)—rare in the first three and common in Cuba. One was taken October, 1899, at Lake Okeechobee, Florida (Mearns)—first record for the State. The species is resident throughout its regular range and breeds for about half the year from March to September.

**[Black Jacana.** *Parra nigra* (Gmel.).

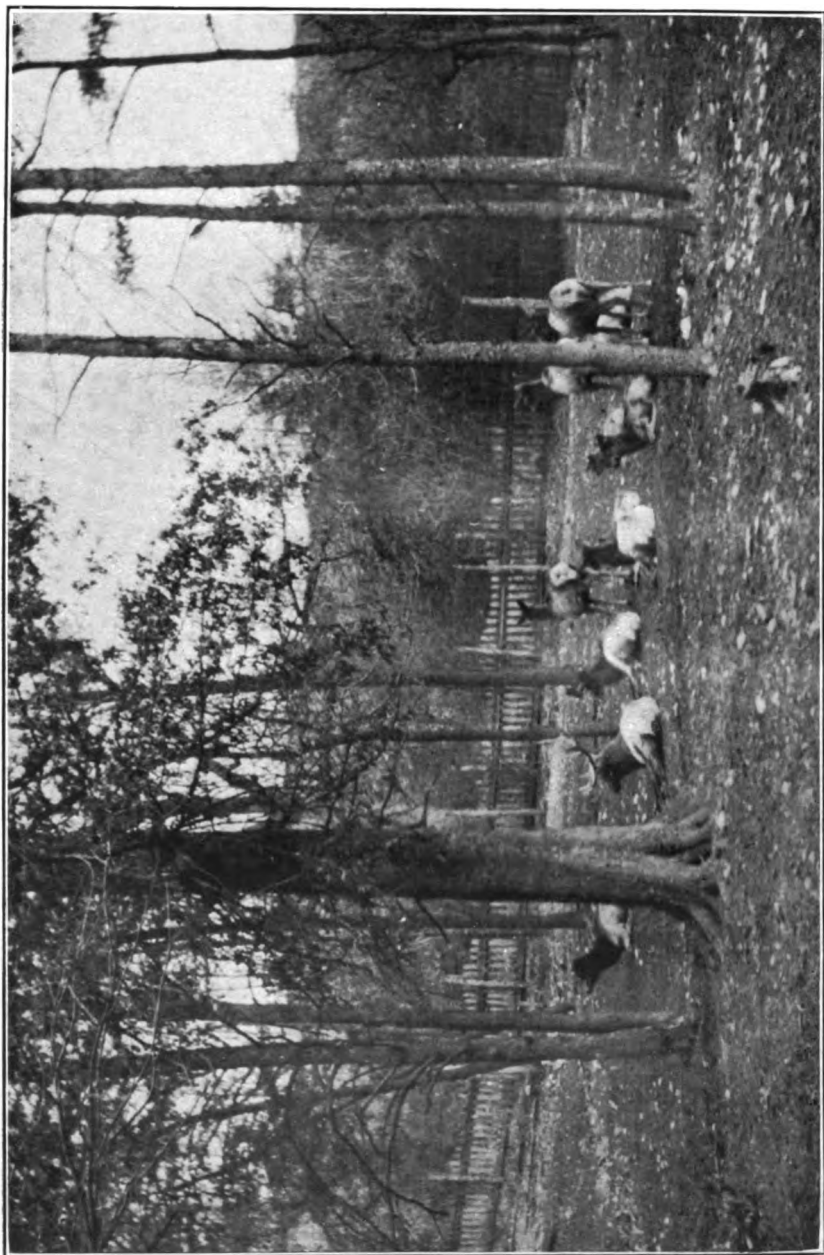
The black jacana is a nonmigratory species inhabiting northern South America and occurring in southern Panama.]

**[Colombian Jacana.** *Parra melanopygia* (Sclater).

A nonmigratory South American species found principally in Colombia, but extending north to Panama.]

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ELK HERD IN THE NATIONAL ZOOLOGICAL PARK, WASHINGTON, D. C.

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U. S. DEPARTMENT OF AGRICULTURE

BIOLOGICAL SURVEY—BULLETIN No. 36

HENRY W. HENSHAW, *Chief*

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# RAISING DEER AND OTHER LARGE GAME ANIMALS IN THE UNITED STATES

BY

DAVID E. LANTZ

*Assistant, Biological Survey*



WASHINGTON

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1910



## LETTER OF TRANSMITTAL.

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U. S. DEPARTMENT OF AGRICULTURE,  
BIOLOGICAL SURVEY,  
*Washington, D. C., Oct. 4, 1910.*

SIR: I have the honor to transmit herewith, as Bulletin No. 36 of the Biological Survey, the results of an investigation by David E. Lantz concerning the practicability and desirability of raising deer and other large game animals in the United States.

In most parts of the country the number of game animals is steadily diminishing and game for table use has already become a high-priced luxury. Experiments have shown that some species, especially of the deer family, can be brought to a state of semidomestication with comparative ease and can be bred and raised at very small cost. The chief purpose of the present bulletin is to call attention to the importance of raising elk and deer for venison, to indicate the particular species most readily reared in preserves, and to emphasize the importance of so modifying state game laws as to encourage the use of private effort and capital in making a marketable commodity of venison and placing it within the reach of people of moderate means. Since the distribution in 1908 of our earlier publication on Deer Farming (Farmers' Bulletin 330) several States have changed their game laws in the interest of this industry, and as its importance becomes known others are sure to follow.

Attention is again directed to the fact that in many parts of the country there are tracts of land of little or no value for agricultural purposes which can be more profitably used for raising venison than for any other purpose.

Respectfully,

HENRY W. HENSHAW,  
*Chief, Biological Survey.*

HON. JAMES WILSON,  
*Secretary of Agriculture.*



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# RAISING DEER AND OTHER LARGE GAME ANIMALS IN THE UNITED STATES.

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## INTRODUCTION.

Under present conditions in the United States, game animals of most kinds are rapidly diminishing in numbers. As game becomes scarcer, legal restrictions upon its pursuit and capture are of necessity increased to avoid complete extermination. Even after game is legally killed, the laws of some States make it impossible for the nonresident hunter either to carry the meat home to his family or to sell it. In the zeal for protecting our fast vanishing game animals, laws have been enacted which, unless modified, will hinder or permanently prevent the most important movement for game preservation yet tried in this country; namely, the propagation of game animals, not by the State alone, but by private enterprise as well.

A few States have recently modified their game laws so as to permit, under limitations, the sale of game from private preserves; but in many States restrictive laws still prevent the grower of such game from marketing it outside the State in which it is produced, or within the State except sometimes during a short open season. Complaint is made that our game laws favor sportsmen of means and are unfavorable to the farmer and to those citizens who, while themselves debarred from the pleasures of the chase, would like occasionally to have game on their own tables. If they could purchase venison grown in preserves, it would remove cause for complaint, and the traffic could be so regulated as not to hinder but to aid the protection of wild game.

It is here urged that if the natural resources of the country are the heritage of the people, they should be conserved for the benefit of all. If private enterprise can help in game preservation, it should be allowed to profit from investments. The propagation of game is as legitimate a business as the growing of beef or mutton; and the producer should be permitted, under reasonable regulations, to dispose of his product at any time, either for breeding purposes or for food.

The present bulletin discusses briefly the importance of domesticating wild mammals and the economic objects to be gained by the process. It calls attention to the species, especially those of the deer

family, most promising for experiments in meat production, and relates successful experience in different sections of the United States with the wapiti, or Rocky Mountain elk, and with the Virginia deer. It discusses the relation of game laws to the business of growing venison—a business which, it is believed, with proper encouragement may be made highly profitable, especially since it will be the means of utilizing much otherwise unproductive land.

### IMPORTANCE OF DOMESTICATING MAMMALS.

The question of practical benefits to be derived from domesticating more species of mammals than we now have is by no means settled. It is claimed by some that the present list of domesticated kinds is ample for all economic requirements of the human race; that, so far as beasts of burden are concerned, we already have enough suited to every necessity; and, furthermore, that mechanical ingenuity is fast bringing us to a time when fewer kinds will be required. As to food animals, we are told that the excellence of our beef, pork, and mutton leaves nothing further to be desired. For clothing, it is said that the wools and hairs produced by mammals already under domestication amply supplement the vegetable fibers.

On the other side, we have the argument advanced by the French zoologist, E. Trouessart, to the effect that mankind should now make every effort to domesticate as many species of mammals as possible. He argues that in the course of time the extensive use of electricity and machinery must inevitably exhaust the coal, petroleum, and natural gas from the earth's crust, and that mankind will again be forced to rely largely upon the labor of animals. He urges immediate action because of the imminent danger of extermination of some of the species.<sup>a</sup>

Between these opposite views a middle ground may be maintained. Admitting that we have enough beasts of burden and as great a variety of animal food as the actual necessities of man demand, we still find excellent reasons for desiring to increase the number of species under domestication. While it is neither necessary nor desirable to domesticate every mammal possible, the field for choice is large. Preliminary to choosing a species its ultimate usefulness must be considered. In reply to the oft-repeated argument that it takes so much time to develop a domestic species that the probable economic advantage will be overbalanced by the enormous expense required, it is enough to recall the fact that many wild animals show remarkable adaptability to the conditions imposed by domesticity. Canada geese, for instance, reared from the eggs of wild parents and kept with barnyard fowls show hardly any trace of wildness.

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<sup>a</sup> Bulletin de la Société d'Acclimatation for 1900, pp. 33-52, 1900.

Young mammals of various kinds when caught wild and reared in captivity become absolutely tame and tractable. If these tame individuals can be bred successfully, there would seem to be few obstacles in the way of domesticating the species.

However, the problems of domestication are not quite so simple as the above statement might imply. It must be remembered that captivity and changes of environment often make wild animals peculiarly susceptible to disease. These and other considerations complicate the problems, whose solution, after all, will depend mainly upon the patience of the experimenter.

In considering the reasons for domesticating wild animals and plants, the æsthetic one should not be overlooked. A large number of the species that have come under human control have been tamed for the pleasure they afford to their owners. This is true of flowering and other ornamental plants, and of some birds—for instance, the canary. Probably this consideration always has weight in the selection of species and individuals for breeding, and it must have a marked influence in deciding the fitness of wild species of mammals for domestication.

Experiments in breeding wild mammals need not necessarily be with a view to complete domestication. The animals may be bred in inclosures giving sufficient range and a habitat as nearly natural as circumstances will permit, and the problems of ultimate domestication may be left for future determination. By this means the practical economic results of full domestication may be largely anticipated before the completion of the process, and the dangers incident to close captivity may be happily avoided.

The chief practical objects to be sought by breeding wild mammals in captivity are: (1) Preservation of species, (2) use in agriculture or transportation, (3) use for hides and fur, and (4) use for food.

#### PRESERVATION OF SPECIES.

The rapacity of man has often threatened the existence of valuable animals. The danger of extinction of the American buffalo, the African elephant, the eland, the walrus, the sea otter, and other species is not imaginary. Within recent times several species of birds have been lost to the world. Of mammals the quagga and the blaubok (*Hippotragus leucophæus*), the latter a small relative of the roan antelope, have been exterminated in South Africa. Foresight might have preserved them, and foresight, aided by governmental intervention, will be needed to prevent the loss of many of the larger game animals of the world. Their preservation is in itself a sufficient reason for attempting their partial or complete domestication.

**USE IN AGRICULTURE AND TRANSPORTATION.**

The need of more kinds of beasts of burden is not great. The horse will never be surpassed in general usefulness in this capacity, and the other animals used in agriculture and commerce are excellent in their places. However, there are parts of the world where for special reasons the domestication of species of the native fauna might be of immense advantage to the people. The zebra and the elephant for Africa and the caribou for arctic America are examples.

**REARING MAMMALS FOR THEIR FUR.**

An important object to be attained by the rearing of wild mammals is the permanence and increase of our supply of furs. The growing scarcity of the better kinds of fur and the consequent high prices make the problem of domesticating fur-bearing animals of immense economic importance, while present conditions promise good returns to those who solve it. The beaver, the otter, the marten, the mink, the silver-gray fox, and the blue fox are among the mammals whose partial domestication and successful breeding would prove profitable.

**REARING MAMMALS FOR THEIR FLESH.**

From the economic point of view, the strongest argument for breeding mammals in captivity lies in their utility as food. For successful game propagation a less degree of domestication in mammals will suffice than when they are reared for fur or for use in agriculture and transportation. This circumstance greatly favors the game propagator. Besides, there is little probability that breeding game as an industry will ever be overdone; the demand for the product is likely to keep pace with the supply.

**SELECTION OF SPECIES FOR REARING EXPERIMENTS.**

The larger game quadrupeds are the first to suggest themselves as suitable for propagation for food. The majority of our domestic mammals belong to the order of hoofed animals (Ungulata), and of these the most valuable food species are in the cloven-hoofed division (Artiodactyla). Pigs, goats, sheep, and oxen belong to this sub-order; and to the wild members of this group we naturally look for additions to the list of domestic food animals.

The number of animals available for rearing experiments is quite large; but from any complete list of those adapted to a particular country a number of promising species would be rejected as superfluous. As a rule the kinds native to a region should have first consideration, since they need no acclimatizing. The selection of a foreign species for breeding must depend upon a similarity between its natural and its proposed habitat or upon its probable adaptability to

the new environment. Adaptation may sometimes be judged from the history of former attempts to acclimatize it or its near relatives. In a country so extensive and varied as the United States the same principles should be considered before transferring a native species from one locality to another.

Some of the large game mammals whose partial domestication in the United States has been favored are briefly considered under the following subheads:

#### THE PRONGHORN, OR AMERICAN ANTELOPE.

The pronghorn (*Antilocapra americana*) is a game animal not closely related to any other living form. While its general characters ally it, as well as the antelopes of the Old World, to the cattle and sheep family (Bovidae), it differs from other living ruminants in its deciduous and forked horn sheaths, and is usually considered as the type of a distinct family.

A half century ago the range of the pronghorn in the plains region extended from the valley of the Missouri River westward to the Cascades and from the Saskatchewan in latitude 53° north, southward to the Mexican border. In Mexico the species is represented by a paler local race. The eastern limit of the original range of the antelope is not definitely known. According to Baird it was abundant in Minnesota on the plains of the Red River in 1850,<sup>a</sup> and it still occurred in the southwestern counties of that State in the early eighties. Pike found it common in eastern Kansas in 1806. The statements of the explorers of the plains indicate that it was about as abundant as the buffalo, although not seen in such vast herds.

The present distribution and numbers of the pronghorn are a sad commentary upon earlier game protection in the West. A few fugitive bands are now to be found in the cattle country from longitude 101° westward. The story of their decrease in all of the States is practically repeated in the statements of D. C. Nowlin, state game warden of Wyoming, in his annual report for 1906. He says that antelope have decreased to an alarming extent throughout the State; for instance, in three years the Green River herd had diminished from about 6,000 to less than 2,000 head. Hundreds had perished through lack of food during storms, by depredations of wild animals, and through slaughter by Ute Indians. He repeats the recommendation of previous reports that the legislature should prohibit all killing of antelope for a term of years.

In 1909 the legislature of Wyoming at last heeded the repeated recommendations of the game warden by passing a law protecting

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<sup>a</sup> Report U. S. Com. Patents (Agriculture) for 1851, p. 121, 1852.

antelope until 1915. Two other States—Montana and Nevada—passed laws in 1909 protecting antelope indefinitely. Washington still has an open season, but the animals are practically extinct in that State. Three Canadian Provinces—Alberta, Manitoba, and Saskatchewan—have open seasons; and of these, Manitoba has had none of the animals for more than twenty years.

In the United States antelope are now protected in every State in which they occur. The close season in Arizona expires March 1, 1911; in Colorado, September 25, 1912; Kansas, March 13, 1918; New Mexico, March 18, 1914; North Dakota, January 1, 1920; Oklahoma, November 1, 1914; South Dakota, January 1, 1911; Texas, July 1, 1912; Utah, March 11, 1913; and Wyoming, September 25, 1915.

Experience shows that the antelope does not do well in close confinement. In zoological gardens it is short lived and seldom breeds. Judge J. D. Caton made a number of efforts to raise antelope in his park at Ottawa, Ill., but the animals died within a year.<sup>a</sup> Other breeders have had similar experience. The difficulty seems to be that of providing a natural environment. Judge Caton stated that the antelope loses its timidity sooner and more completely than any other wild animal whose domestication he had attempted. "When taken young it soon acquires the attachment of a child for the human species, and when captured adult in a short time becomes so tame that it will take food from the hand, and follow one by the hour walking through the grounds." None of Judge Caton's antelope bred, and he concluded that the climate was too humid, and that his pasture lacked the vegetation essential to their health.

The experience of those who have tried to rear the antelope outside its natural range should not deter those who are favorably situated from undertaking further experiments with it. Visitors to Yellowstone National Park have been greatly surprised at the tameness of the antelope herds. Many western ranchmen have successfully reared the young. The animals were allowed perfect freedom, but could not be driven from the premises where they were fed. Reared in natural surroundings, unconfined, and with sufficient range, they would undoubtedly thrive and increase. In a few years by careful and continued taming of the young, one might secure a herd of absolutely tame antelope. Antelope require only a slight fence to confine them. They run very swiftly, but unless closely pressed will not jump an ordinary fence.

The flesh of the young antelope is said to be much superior to ordinary venison. That of mature animals, particularly the males, has a strong flavor; but this might be greatly improved under domesti-

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<sup>a</sup>American Naturalist, X, 197, 1876.

cation. A full-grown pronghorn weighs from 100 to 125 pounds, and will dress from 65 to 80 pounds.

#### EXOTIC ANTELOPES.

The Old World antelopes belong to the family of Bovidæ, and include many valuable food animals. In Africa alone over a hundred species occur, many of them hardy and most of them excellent game. Fully a score of species would be promising subjects for acclimatizing in America. Africa, like our own country, has arid sections, and some of her antelopes are probably especially adapted to the desert lands of our Southwest, and might be used to restock parts of that region from which our own pronghorn has been exterminated. Some years ago a society was organized for the purpose of introducing the gazelle into southern California, but no practical results followed.

#### THE ELAND.

The eland (*Taurotragus*), the largest of the antelope family, is threatened with extermination over the greater part of its range in South Africa. Its average weight is from 800 to 1,100 pounds, and old males have been known to attain a weight of 1,400 to 1,500 pounds. This animal has often been recommended for rearing in captivity because of the excellence of its flesh, which is superior to beef. Harris, the African traveler, states that while it resembles beef in grain and color, it is far better flavored and more delicate, possessing a pure game flavor and remarkable for the quantity of fat interlarded between the muscles.

The eland was introduced into Holland by the Prince of Orange in 1783. It was acclimatized in England by the Earl of Derby in 1842, and was bred successfully in his parks. After his death the herd passed into possession of the London Zoological Society in 1851, and continued to increase in numbers for many years. In 1899 the Duke of Bedford had a fine herd of 14 elands in the park at Woburn Abbey.

The scarcity of this game animal in a wild state and the consequent cost of obtaining stock would probably make experiments in breeding it in the United States so expensive as to prohibit the attempt by individual enterprise. However, the experience with the animal in Europe gives assurance that, if properly undertaken, efforts to acclimatize it in the United States would be successful.

#### THE NILGAI.

The nilgai (*Boselaphus tragocamelus*) of India is, next to the eland, the largest of antelope. The animal is ungainly in appearance, and its flesh is somewhat inferior to that of the eland, but its

size, its hardiness, and its lack of wildness commend it as a species suitable for domestication. It stands long droughts extremely well, and its flesh is equal to most venison in quality.

Nilgais were first taken to England in 1767. In 1862 a dozen of the animals were introduced into the park of Signor Comba at Mandria, Italy. In ten years the herd increased to 172 head. A small herd is kept by the Duke of Bedford at Woburn Abbey, England. In the National Zoological Park, the Philadelphia Zoological Gardens, and the New York Zoological Park these animals have done well and bred regularly.

#### SMALLER ANTELOPES.

Some of the smaller members of the antelope tribe are excellent subjects for experiments in acclimatization and breeding in the United States. Among them are the gazelles of Asia and Africa, the duikers, the springbuck, and the roan antelope of Africa, and the Indian antelope, or black buck. Of the duikers (*Cephalophus*) there are over twenty kinds, ranging in size from that of a medium-sized donkey to that of a hare; and all are said to afford excellent venison, while some of them are known to be easily tamed. The Indian antelope, or black buck, has been bred in many zoological gardens, and a herd is kept in the park at Woburn Abbey. It is easily tamed, but, as is the case with many deer and antelope, the tame males become ill-tempered in the pairing season. In the Philadelphia and New York Zoological parks these animals have thrived and increased rapidly.

#### IMPORTANCE OF THE DEER FAMILY.

The deer family (*Cervidæ*) stands next to the cattle and sheep family (*Bovidæ*) in general utility. The flesh is a valuable food, while the antlers or horns, as well as the skins, are important articles of commerce. Venison was more common than beef on the tables of medieval Europe, and was the flesh most commonly eaten by early settlers and frontiersmen in North America. Its dietetic value is enhanced by the fact that it is especially adapted to invalids who require a nourishing yet easily digested food.

In a recently published table showing the time required to digest various foods, grilled venison is given first rank with boiled tripe and boiled rice, as requiring but one hour for complete digestion. Whipped raw eggs, boiled barley, and boiled trout, as well as asparagus and a few other vegetables, require an hour and a half. Grilled beefsteak and mutton require three hours for digestion, while grilled or roasted veal and pork require five hours, or even more.<sup>a</sup>

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<sup>a</sup> Scientific American, C1., 46, July 17, 1909.

Except in a few species like the caribou, only male deer have antlers. Although these horns are deciduous, they are solid processes produced from the frontal bone, and have the physical as well as the chemical properties of true bone. They are of two general types—those more or less broad and flat and those rounded in shape. Those of the flattened type are usually the more massive, but the rounded antlers of the wapiti are exceptionally heavy.

Deerhorn has several uses. It produces much gelatin by decoction, the product being like that from most animal substances. The raspings and waste pieces of the horns used in manufacturing knife handles are either made into gelatin or boiled down into size used in cloth manufacture. At one time deerhorn was a prominent source of ammonia.

The principal use of deerhorn is in the manufacture of handles for knives, forks, and other instruments. In Sheffield, England, some thirty years ago, about 500 tons of deerhorn were used annually in manufacture. India and Ceylon furnished about four-fifths of this material, while about 100 tons came from European and English deer forests. The 500 tons represented the antlers of fully 350,000 deer of various species.<sup>a</sup> In Europe buckhorn is worked up into many useful articles, as umbrella stands, chandeliers, and ornaments for personal wear.

The use of deerskins is well known. As tanned and dressed by the American Indians they are manufactured into a variety of useful and ornamental articles. The inhabitants of some of the Indian villages of the North derive a good income from their manufactures of deerskins into moccasins, rackets, toboggans, and other things for sale. Deer hide makes an excellent leather, its value depending upon the size as well as upon the species from which it comes. The skins of wapiti, for instance, are porous, and the leather does not wear well, while those of the moose and European elk are so thick and hard that the leather is said to have resisted musket balls. In Sweden in former times a pair of elk-hide breeches went as a legacy through several generations of peasants. Formerly about 200,000 deerskins from North America were sold annually in the London market. Half of these were skins of the wapiti. Many were bought for Germany and there manufactured into leggings, but the heavier skins were tanned and manufactured in England. In recent years the export of deerskins from America has fallen off greatly.

Deer hair has a peculiar cellular structure, and is used in some parts of the world for stuffing saddles, for which purpose it is especially suited.

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<sup>a</sup> Simmonds, P. L., *Animal Products*, p. 182 (not dated).

## NATIVE DEER OF NORTH AMERICA.

North America is comparatively rich in species of deer. All of them are valuable food animals, and nearly all have been of great commercial and economic value during the development of the country. While their commercial importance has been greatly lessened as their numbers diminished, they still play an important part in furnishing food in newly settled parts of the United States and Canada, as well as in feeding the native tribes in the far North. Except in States that have extensive forested areas and have protected deer for a series of years, they are rapidly disappearing before the encroachments of agriculture. The remnant are valuable chiefly because they are a natural resource which may be indefinitely developed if carefully husbanded. It is believed that with partial domestication and careful management in state and private game preserves, deer of most of our species may again become abundant. Considering the difficulties, attempts to domesticate them have been fairly satisfactory.

## THE CARIBOU.

Several species and local races of the caribou, or reindeer, inhabit the northern part of North America. According to habitat, they fall naturally into two groups. The more northern, ranging beyond the forests, is best represented by the barren-ground caribou (*Rangifer arcticus*). The second group inhabits the forested area south of the other, and its most important representative is the woodland caribou (*Rangifer caribou*). Although they differ little from the wild Old World reindeer (*Rangifer tarandus*) in habits and general appearance, no attempts to domesticate the American reindeer seem to have been made. The larger woodland caribou is said to be exceedingly wild and timid, and for this reason its suitability for domestication has been questioned. The barren-ground species, although small, appears to be much less wild.

Prof. S. F. Baird was strongly of the opinion that American caribou of both groups are as capable of domestication as the European species, and he suggested that such a step would be of vast benefit to Indians of the North. Its success would at once place these people beyond the vicissitudes which are so rapidly sweeping them off. In the end they might "become a pastoral people, and possibly, in time, as agricultural as the nature of the seasons would admit."<sup>a</sup>

In the same paper from which the above quotation is taken Professor Baird suggested further that the domesticated European reindeer might itself be successfully imported and propagated in North

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<sup>a</sup> Report U. S. Com. Patents (Agriculture) for 1851, p. 108, 1852.

America, and that thus the loss of time in attempts to domesticate a wild species might be avoided. After the purchase of Alaska by the United States, the introduction of firearms among the natives led to such slaughter of game that actual starvation threatened some of the tribes. In 1887 Charles H. Townsend advised that the Government should import the reindeer and teach the natives how to care for and use the animals. In 1891 the late Dr. Sheldon Jackson, general agent in Alaska of the Bureau of Education, aided by donations from private sources, purchased a small herd of reindeer abroad. They arrived in Alaska in 1892. Since 1894 Congress has made annual appropriations for continuing the experiment. Up to and including 1904, the total number of reindeer imported from Siberia and Scandinavia was 1,280, and at that time the herds numbered over 8,000. The net annual increase since importations ceased has been about 25 per cent. In 1907 the herds numbered 15,839 animals and the present number is probably not less than 23,000. The introduction of these animals has already proved to be of immense benefit to the natives, who have been taught how to manage them by herders from Lapland and Finland, brought to America for this service.

Through the efforts of Doctor Grenfell, Lapland reindeer have recently been introduced into Labrador and northern Newfoundland, and the experiment promises great success. W. J. Carroll, of St. Johns, Newfoundland, in commenting on the work of Doctor Grenfell, says:

"It is to be hoped that the introduction of reindeer will be the first step toward the domestication of our own caribou. With a quarter of a million of caribou running wild in the interior, increasing at the rate of 10,000 yearly, it will be seen that when Newfoundland wakes up to the possibilities of its caribou herds we will not only be able to have thousands of deer for commercial purposes, but also will have enough to keep this island a paradise for hunters when hunting big game on the continent becomes a thing of the past. As an instance of how they increase and multiply, Doctor Grenfell thinks his herd will be increased by 200 fawns this spring."<sup>a</sup>

While the domestication of the American caribou has been made less important by the introduction of the reindeer, good reasons for breeding the native animals still remain. They would probably be especially useful for crossing with the Old World species. The cross with the woodland caribou would doubtless produce animals of greater size and strength, and the native caribou could constantly be drawn upon for new blood, just as has often been done in the case of the wild reindeer of northern Europe and Siberia.

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<sup>a</sup> Forest and Stream, LXX, 611, April 18, 1908.

## THE MOOSE.

The largest living animal of the deer family is the moose, represented in America by a widely distributed species (*Alces americana*). The Alaskan moose, on account of its great size, has been described as a separate species (*Alces gigas*). The European elk (*Alces machlis*) differs but slightly from the common moose of North America.

The moose is still found in some of the wooded parts of Canada, from Nova Scotia and New Brunswick to Manitoba, its range extending into the United States in northern Maine, Michigan, and Minnesota. In the Rocky Mountain region it ranges from northwestern Wyoming northwestward into Alaska. It is still fairly abundant in parts of Alaska and in British Columbia. Under a careful system of protection moose have slowly increased in numbers in Maine. A promising attempt has been made to reintroduce them into the Adirondacks, where they were exterminated nearly fifty years ago.

Perhaps no other American deer is naturally so well adapted to domestication as the moose. Professor Baird relates that a pair of the animals were kept by a man living near Houlton, Me. These had been trained to draw a sleigh, "which they did with great steadiness and swiftness, subject, however, to the inconvenience that, when they once took it into their heads to cool themselves in a neighboring river or lake, no effort could prevent them."<sup>a</sup> Audubon relates another instance of a moose's being trained to draw a sleigh. We are informed by a number of writers that the European species was in former times fully domesticated in northern Scandinavia and, like the reindeer, was used to carry couriers from place to place. They were swifter than reindeer and have been known to draw a sleigh 234 miles in a day. It is said that this use of elk was finally forbidden under heavy penalties on account of their having been employed to facilitate the escape of prisoners or suspected criminals, and the domestication of the animals was consequently abandoned.

Dr. W. T. Hornaday says of the moose that in captivity "it is docile; not foolishly nervous like most deer, but steady, confiding, and affectionate. Moose are easily handled and trained to drive in harness, and in contact with man manifest more common sense than any other species of deer with which I am acquainted."<sup>b</sup>

In spite of this natural tendency to tameness, the efforts that have been made to keep moose in confinement have nearly all failed. A pair were kept in the Cincinnati Zoological Garden for about five years, but this experience is exceptional. Dr. Hornaday expresses

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<sup>a</sup> Report U. S. Com. Patents (Agriculture) for 1851, p. 115, 1852.

<sup>b</sup> The American Natural History, p. 141, 1904.



ELK IN THE NATIONAL ZOOLOGICAL PARK, WASHINGTON, D. C.



the belief that the failure is largely due to lack of vigorous daily exercise, which he thinks vitally necessary for the proper digestion and assimilation of their food.\* Others have suggested that most of the experiments have been made outside of the natural range of moose, and that the climate was too warm for them. On the other hand, individual moose reared away from the parent cow have done well as long as they had the freedom of the forest; and in large preserves, such as the Blue Mountain Park in New Hampshire, the animals are said to thrive and increase. The difficulties in the way of raising them within their natural range are by no means insurmountable, and the practicability of breeding them when confined to forested areas within the Canadian life zone has been proved.

## THE WAPITI.

The round-horned elk of North America are best represented by the Rocky Mountain wapiti (*Cervus canadensis*) (Plates I and II); but, besides the typical form, two species and a geographic race occur.

Next to the moose, the wapiti or elk is the largest American deer. Though not a true elk, the name has become too firmly fixed in our vernacular for change. This magnificent game animal was once abundant over a large part of the United States, and extended its range northward in northwest Canada to about latitude 60° in the Peace River region. Southward it ranged to the southern Alleghenies, northern Texas, southern New Mexico, Arizona, and California. The limits of its range eastward were the Adirondacks, western New Jersey, and eastern Pennsylvania. Westward it occurred to the Pacific Ocean.

At present the range of the elk has so far diminished that, outside of the larger herds left in the Yellowstone National Park and the mountainous country surrounding it, the animals occur only in a few scattered localities. The herds in the national park and its vicinity are said to number about 30,000 head. Smaller numbers of the elk still occur in Colorado, Idaho, western Montana, western Oregon, northwestern California, and the Olympic Mountains in Washington. A remnant of the dwarf species of southern California is left in the upper San Joaquin Valley. Outside the United States, a few elk remain in southern Manitoba, Alberta, and on Vancouver Island.

In addition to the wild herds, a considerable number of elk are left in private game preserves and parks, as well as in nearly all public zoological gardens and parks of the United States. These form the nucleus from which, with good management, we may expect

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\* Hornaday, Wm. T., The American Natural History, p. 141, 1904.

a restocking of some of the former ranges of the elk, and from which also a profitable business of raising the animals for market may be developed. At the present time no other member of the deer family seems to offer so promising a field for ventures in breeding for profit. Details of management and records of experience in breeding the elk will be given in another part of this bulletin.

#### WHITE-TAILED DEER.

The common deer of the United States is the whitetail, or Virginia, deer (*Odocoileus virginianus*). The species is widely distributed and, including the half dozen geographic races that occur within our borders, the range of this deer includes nearly all the United States, except large parts of Utah, Arizona, California, Oregon, and Washington. It is extinct in Delaware and practically so in several States of the Middle West; but it is still fairly common over the greater part of its original range. A number of nearly related species occur south of our borders.

The whitetail is the best known of our native deer and has been bred in semidomestication in many localities. Its suitability for parks is unquestioned, and in large preserves it increases very rapidly. It has not always done well, owing to diseases, but the difficulties in the way of rearing it successfully are not greater than those that attend the management of some of our domestic animals. Its habits and management are discussed later.

#### MULE DEER.

The mule deer (*Odocoileus hemionus*) (Plate III, fig. 2) is larger than the whitetail, and, though less widely distributed than that species, had originally a vast range on the western side of the continent. Including the six subspecies, or geographic races, it occurred from the Missouri River westward to California and southward into Lower California and Sonora. East of the Continental Divide its range extended north into British Columbia, Alberta, and other provinces to latitude 56° or 57°, and south into Texas. This range has been greatly diminished by the encroachments of settlements and the lack of protecting laws, but the animals are still fairly common in scattered localities except in the open plains country.

Outside of its natural range the mule deer has seldom thrived. Indeed, many of the attempts to acclimatize it east of the Mississippi have failed. In zoological gardens the animals often die of diseases of the digestive organs, but in several places they do fairly well and have bred. They seem to have been thoroughly acclimatized in the large park belonging to the late William C. Whitney,

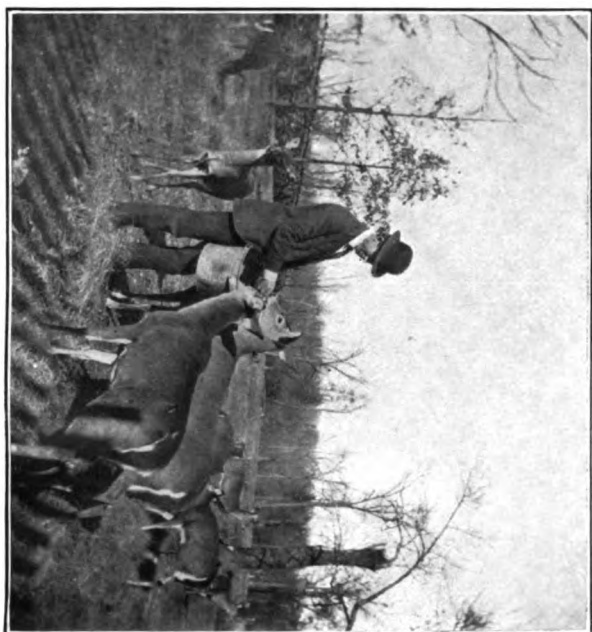


FIG. 1.—FEEDING TIME ON FARM OF C. H. ROSEBERRY,  
STELLA, MO.

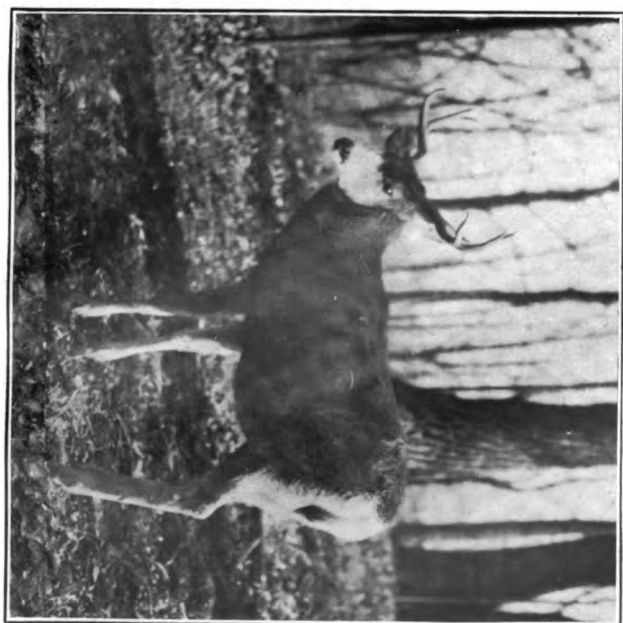


FIG. 2.—MULE DEER, NATIONAL ZOOLOGICAL PARK,  
WASHINGTON, D. C.



near Lenox, Mass., and they have bred regularly and done well in a small paddock at Crawfordsville, Ind.

The mule deer has been crossed with the Virginia and other deer, and hybrids with the southern Virginia deer have shown a superiority over that race in size and stamina. The hybridizing experiments already made give promise of an unexpected usefulness for the mule deer in captivity. Aside from the difficulty of acclimatizing it in humid regions, no unfavorable circumstances concerning it are known. It is prolific, its venison is excellent, and its superior size adds to its value as a market animal.

#### COLUMBIA BLACK-TAILED DEER.

The Columbia black-tailed deer (*Odocoileus columbianus*) is smaller than the mule deer or the typical Virginia deer. With its two geographic races it inhabits the Pacific coast west of the Cascades in northern California, Oregon, Washington, and British Columbia to southern Alaska. Although its home is in a humid country, it has resisted nearly all efforts to introduce it into the eastern United States, and the managers of zoological parks and gardens have about abandoned attempts to keep it. If not closely confined, it does well in parks and preserves within its natural range.

#### EXOTIC DEER.

Several species of exotic deer have been acclimatized in America; and, since the vast extent of our territory affords a great variety of conditions, it is probable that many more species could be successfully introduced and bred in suitable localities. The red deer and the fallow deer of Europe seem to be well adapted to diverse climates, and are now to be found thriving in parks in many parts of the world, including the United States. A few other species whose habits and general usefulness commend them as excellent subjects for domestication are here named.

#### THE ALTAI WAPITI.

This wapiti (*Cervus asiaticus*)\* occurs in the Altai and Thian Shan mountains, and is one of the few deer that have been extensively kept in semidomestication. Large herds of these animals were formerly trapped in inclosures in the Altai Mountains and are kept in captivity for the sake of their antlers, which are cut when in the velvet and exported to China for use in medicine. About 6,000 of the animals are said to be in captivity, but owing to their destruction by hunters,

\* The proper scientific names of many exotic deer are in doubt. In this and one or two other instances the names here adopted are those used by Lydekker in his recent books on big game.

wild wapiti of this species are now rare. Although this wapiti is smaller than the American species, the antlers are much larger. They sell at about 15 roubles (\$7.50) a pound, and a single pair sometimes brings 120 roubles (\$60).<sup>a</sup>

The Altai wapiti has been kept in parks in various parts of Europe, notably at Woburn Abbey, where the Duke of Bedford in 1896 introduced three stags and several hinds, purchased from Mr. Hagenbeck, of Hamburg. They have done well, but are in no way superior to the American wapiti, with which they interbreed. The Altai wapiti has bred in the Philadelphia Zoological Gardens.

#### THE JAPANESE SIKA.

Experiments in breeding the Japanese sika (*Pseudaxis nippon*) in Europe and America show that it is one of the most promising of the deer family for park purposes. It inhabits northern China, Manchuria, and Japan, but the Japanese race has been oftenest the subject of experiments in breeding.

One of the earliest to try this species in European parks was Viscount Powerscourt, of Powerscourt, in Wicklow, Ireland. In 1860 he purchased from Jamrach, the London dealer, a stag and three hinds and removed them to his estate, where they thrived and multiplied greatly. In 1884, after twenty-four years of breeding and increase, his herd consisted of over 100 individuals, although 2 or 3 yearly had been shot, many given away, and others sold. Several deer parks in Ireland, England, and Scotland were stocked with this species from Powerscourt, and the animals thrived well in every place to which they were taken.

In 1879 Lord Powerscourt wrote:

Japanese deer require no care of any kind; they are as hardy as fallow or red deer, and the venison is as good. We had a haunch last year with more than 2 inches of fat on it. The haunches are small and of a handy size.<sup>b</sup>

Again, in 1884, he said:

These pretty little deer are the only [introduced] ones which have multiplied, and have also never required any shelter of any kind, nor any winter feeding, except what the ordinary red deer and fallow deer get, such as hay, etc. \* \* \* The Japanese deer here have undoubtedly interbred with the red deer; there are three or four deer in the park here which are certainly hybrids, the red hind in each case being the dam. The Japanese are a most satisfactory little deer; the venison when dressed is about the size of Welsh mutton and very well flavored. The little stags, with their black coats and thick necks, like miniature sambur, are very picturesque and ornamental, and I think they are a decided addition to our varieties of hardy park deer. Some of them are always to be seen in the Society's gardens, but these give no idea of the beauty of the animals when in a wild state in a park.<sup>c</sup>

<sup>a</sup> Lydekker, R., Great and Small Game of Europe, Asia, and America, p. 67, 1901.

<sup>b</sup> Proc. Zool. Soc. London for 1879, p. 294, 1879.

<sup>c</sup> Proc. Zool. Soc. London for 1884, pp. 208, 208, 1884.

Although the Japanese sika will take boughs when offered, it is chiefly a grazing animal. It is a rough feeder and thrives on the same food that cattle eat. The fact that it flourishes in the humid climates of Ireland and the Hawaiian Islands shows that it would probably do equally well in almost all parts of the United States. It has been successfully bred in most of the zoological parks of this country, and no obstacle to its successful propagation in open parks is known.

The Peking sika (*Pseudaxis hortulorum*) is larger than the Japanese species, much more vividly colored in summer, and, judging from the experience of the Duke of Bedford with his herd at Woburn, it also is admirably adapted for private parks in humid parts of our country.

#### THE PÈRE DAVID DEER.

The Père David deer (*Elaphurus davidianus*) is mentioned here because the species is now unknown in a wild state. When discovered by Père David none were known outside of the herds in the Imperial Park of the Emperor of China. The subsequent destruction of the imperial herds in 1894 left the few individuals that had been taken to Europe, and their progeny, the only known living representatives of the species. It is now thought that the herd at Woburn Abbey are the sole survivors. They seem to be thoroughly acclimatized there and to be increasing from year to year.

#### INDIAN SAMBAR.

The Indian sambar (*Cervus unicolor*) is a large species with several geographic races. Although Lord Powerscourt failed to acclimatize these animals in his park in Ireland, they flourish at Woburn Abbey, where they are kept in the open. At Powerscourt the dense thickets and lack of sunshine were fatal to these deer. The species does well in zoological gardens and public parks, and it has often been recommended for private preserves. Like the wapiti, the male is vicious during the rutting season.

#### AXIS DEER, OR CHITAL.

The chital or spotted deer (*Cervus axis*) of India and Ceylon is one of the handsomest of ruminants. It is one of the few deer that is spotted with white throughout the year. The species has been successfully bred in European parks and in zoological gardens in many parts of the world. Although native to a warm country, it does well in England and the United States. At Woburn Abbey the herd is always in good condition. Its beauty makes it very desirable for parks. Unlike our native deer it sheds its horns irregularly and breeds at almost any season. It has been crossed with the Virginia deer.

## SMALL DEER.

The exotic species thus far mentioned are as large as our common deer, or larger. On our American farms and ranches, especially in the South, there is a distinct demand for a food animal of smaller size than the sheep for family use. A number of species of small Asiatic deer might admirably fill this want. Among them are several of the muntjacs (*Cervulus*) and the Chinese water deer (*Hydrelaphus inermis*).

The Indian muntjac (*Cervulus muntjac*) is probably the best-known species of this genus. It is a beautiful little deer, with small horns, and stands 20 to 22 inches high. The animals live in thickets and tall grass, and are said to be solitary except when pairing. They are timid and seldom seen except when running away from beaters. When cornered they defend themselves with the long canine teeth and not with horns and hoofs like other deer. The period of gestation is six months, and two young are produced at a time. The animals feed like sheep on almost any herbage. They thrive in English parks and would probably flourish in our Southern States. The flesh is said to be excellent.

The Chinese water deer is less solitary in its habits, but in size and some other characteristics it is like the muntjacs. It is the most prolific of all the deer family, the female producing three or four young at a time. It is suited to marshy lands.

If any one of the various small species of deer or even antelope could be raised in the Southern States, it would furnish the farmers a much needed form of meat, which could be provided fresh every day or two as needed. Aside from fowls most of our domestic animals are too large for immediate consumption by the ordinary farmer's family. The successful introduction and breeding of a small mammal, in size intermediate between a hare and a sheep, would be of sufficient economic importance to warrant the expenditure of considerable sums of money in experiments. But this statement is true also of the domestication of any other deer.

## OBJECTIONS TO THE INTRODUCTION OF FOREIGN ANIMALS.

In suggesting the acclimatization of foreign game animals, the Biological Survey does not advocate their indiscriminate introduction into the United States nor the immediate release of any of them to resume their wild life. The history of the introduction of beneficial animals into new localities should teach caution in such experiments. Even species fully domesticated have become injurious when neglected and allowed to run wild. Devastations of crops by horses, cattle, pigs, and goats, introduced into new countries for domestic use and afterwards abandoned, have been known in many parts of

the world. The destruction of native birds and mammals by dogs and cats that have gone wild furnishes an equally valid argument for caution. Probably less danger attends the acclimatization and release of the class of animals under discussion than any other; and yet it is known that deer and antelope under certain circumstances have increased so enormously as to destroy important crops. Ordinarily should they prove injurious in the United States, the removal of protection would be followed by their speedy extermination as game.

### THE WAPITI, OR ROCKY MOUNTAIN ELK.

#### HABITS.

In this bulletin the life history and habits of the Rocky Mountain elk are discussed only so far as they bear on the care and management of the animals in captivity or in game preserves.

On account of its size, the elk holds a place among American deer much like that occupied by the red deer among European Cervidæ. Although a larger species, its general resemblance to the red deer caused early immigrants to apply that name to it. In New England, where there were no elk, the common Virginia deer was called the red deer. This confusion of names probably led to the adoption of the name elk for the wapiti because of its size. In view of its resemblance to the red deer so common in parks in the Old World, it seems strange that attempts to domesticate the wapiti in America were so long delayed.

The elk is both a browsing and a grazing animal. While it eats grass freely and can subsist upon it alone, it thrives best where there are also trees and underbrush. In its former range, when the surroundings permitted, it retreated into mountains and woodlands in summer, where it fed upon buds, twigs, leaves, and woodland grasses, while in winter it grazed chiefly in open prairies or glades, unless driven to timber by deep snows. The Wyoming herds summer chiefly in the high mountain pastures of the Yellowstone Park, and when these become covered with deep snow the animals retreat to the valleys southward and eastward of the park. They formerly ranged far out on the plains in winter, but intense summer grazing by cattle and sheep now leaves the winter pasturage too scant for them.

The American elk is extremely polygamous. The horns of adult bulls usually drop off in March or April, and new ones attain their full size within ninety days. The velvet adheres until about August, when it is gradually shed. The animals hasten the shedding by thrashing their horns against small trees and bushes. This is often referred to by hunters as "shaking," from the fact that the motion of the trees may be seen at great distances. The bulls usually lead solitary lives while the horns are growing, but early in September,

when the antlers are fully matured, the rutting season begins, and the bulls seek the herds of cows. Fights for supremacy then take place, and the victor takes charge of as many cows as he can round up and control.

In spring the cows remain in small herds until nearly time for the calves to be born. Then each seeks a secluded place, where she remains until the calf is strong enough to follow. In late summer the cows and calves begin to collect into small herds and are soon joined by the bulls. The period of gestation in the elk is from 249 to 262 days (average about  $8\frac{1}{2}$  months). The calves are born in May or June and, like the young of the common deer, are spotted, but the spots are not so numerous nor so clearly defined, and they disappear in September with the first shedding of the hair. The female elk does not have young until three or four years old, and usually produces but one calf at a time. The calf follows the cow for a full year and sometimes even longer.

#### ELK VENISON.

The flesh of the elk is superior in flavor to most venison. The bulls are in best condition about the time the velvet is shed. By the time the rut is over, in October, the flesh is in the poorest condition. As the hunting season is usually in October and November and only males are killed, sportsmen often obtain the venison in poor condition, and, as a result, many persons have found fault with the flavor of elk meat. It is not best when freshly killed, but after hanging four or five days it becomes palatable and nutritious. Of course fat elk are better than lean, and it is said that the venison from castrated bulls is superior to that from others.

#### PRESERVATION OF THE ELK.

The preservation of the Rocky Mountain elk is of even greater importance than that of the American buffalo. While the destruction has not gone so far as in the case of the buffalo, absence of the elk from nineteen-twentieths of its former range is to be even more regretted. The buffalo was especially adapted to the prairies and the plains, and economically its place is better filled by the domestic cattle that now graze there. On the other hand, the elk is equally well, if not better, suited to rough, wooded areas not well adapted to cattle. Its preservation, therefore, may economically utilize such land, and the animals may become a valuable resource to the State as well as to the private owner.

The value of game to the State is seldom so fully appreciated that it is properly conserved and made to yield permanent returns. Maine probably secures the best value from its big game. Deer and moose

in that State now pay a large part of the cost of game protection; the addition of a small resident license fee for hunting would make the actual revenue exceed considerably the cost of fish and game preservation. In addition, licensed guides earn about \$360,000 a year, while hotel keepers, railroads, express companies, and others derive greatly increased incomes from the sportsmen and tourists who are attracted to the State by its excellent hunting and fishing. Any State that has big game may profit by its preservation, and owners of private big game preserves should find them equally remunerative.

Its polygamous habit is a favorable factor in preserving the elk. The extermination of the buffalo was hastened by the fact that hunters, both white and native, preferred to kill the cows. Their flesh was superior to that of the bulls, while the robes they produced were of finer quality. In the course of time polyandry became so fixed among buffaloes that reproduction fell much below the normal rate. In the case of the elk, polygamy is the rule; and the destruction for trophies of males only, as well as the laws of States which forbid the killing of does, serves to perpetuate the species. The breeding of the animals is thus kept at a maximum rate.

The fact that elk congregate in large herds in winter has been unfavorable to their preservation. Pasture in their winter ranges is often insufficient for the demand, and the weaker animals perish. In recent years, because of the encroachments of cattle and other stock upon the range, elk winter higher up in the mountains, where the snowfall is great. Poachers wearing snowshoes often approach and destroy an entire herd. Under adequate protection and with a proper supply of winter forage the gregarious habits of the elk would give increased security to the herds, but conditions hitherto have not brought about such results. On the contrary, wherever elk have been abundant much unlawful slaughter of the animals has taken place. Not only have nonresident hunters engaged in the business of killing them for heads, hides, and tusks, but residents of the game country have sometimes engaged in the same nefarious practice.

#### WILD ELK IN THE EASTERN UNITED STATES.

Probably the last wild elk of the original stock east of the Mississippi was killed in November, 1867, in Elk County, Pa., though possibly a few remained a little longer in the mountains of West Virginia. A few wealthy men have stocked private preserves with elk from the Rocky Mountains, and the experiment of acclimatizing them in the East has proved uniformly successful. A number of preserves in New Hampshire, Massachusetts, New York, New Jersey, Pennsylvania, and North Carolina have been noted for fine herds of these animals, the best known, perhaps, being those of Austin Corbin

and William C. Whitney, both deceased. The Corbin preserve is on Croyden Mountain, near Newport, N. H., and the Whitney preserve was on October Mountain, near Lenox, Mass. At Mount Pocono, Pennsylvania, Carl Tielenius has a considerable herd of elk, kept on lands over which the wild elk ranged in the early part of the last century.

The New York Forest, Fish, and Game Commission have made in the Adirondacks the first systematic efforts in the East to restore elk to their former ranges. In June, 1901, the late William C. Whitney presented 22 head of elk—5 bulls and 17 cows—from his Massachusetts herd. This was followed in 1902 and 1903 by two gifts of larger herds from the same source and in 1906 by a gift of a herd of 26 from Mr. Corbin's Blue Mountain Forest Park, in New Hampshire. The elk were liberated in small bands at various places, mostly on state lands, and their increase has been satisfactory. It was estimated that on December 31, 1906, the total number at large in the Adirondacks was about 350 head.<sup>a</sup> The elk, under proper protection, may be expected to become abundant again in the North Woods. The example of New York might well be followed by all States that have wild lands suitable for the elk. Pennsylvania has ideal places for the animals in her game preserves recently established, and all the States traversed by the Allegheny Mountain ranges have abundant wild lands for the introduction of the species. The cost of stocking with the animals would be slight compared with their ultimate value to the State. In New Hampshire there is reason to suppose that the beginning of a wild herd exists in animals that have escaped from the Corbin preserve. Forty-eight elk in one herd are reported to have been recently seen running at large in the forests.<sup>b</sup>

#### EXPERIENCE IN RAISING ELK.

Although the American wapiti is less prolific than the common deer and some other species that have been bred in parks, it increases quite as fast as the red deer and is more hardy and easily managed. It has been successfully acclimatized in many parts of the world, and in England and on the Continent it has been crossed with both the Altai wapiti and the red deer. The hybrids in both cases were superior to the native stock in size and stamina.

The elk has been successfully bred in confinement in many parts of the United States, and in some instances has been domesticated. Audubon and Bachman say of it:

This species can be easily domesticated, as we have observed it in menageries and in parks both of Europe and America. The males, like those of the Vir-

<sup>a</sup> Field and Stream, XII, 598, November, 1907.

<sup>b</sup> Recreation, XXVII, 129, March, 1908.

ginia deer, as they advance in age, by their pugnacious habits are apt to become troublesome and dangerous. The elk lives to a great age, one having been kept in the possession of the elder Peale, of Philadelphia, for thirteen years; we observed one in the park of a nobleman in Austria that had been received from America twenty-five years before.<sup>a</sup>

Professor Baird was of the opinion that the elk could easily be domesticated, and that, next to the caribou and the moose, it is the "one to which we are most entitled to look for an increase of our stock of domestic animals. The great size of the horns of the male, and his fierceness and uncontrollability during the rutting season, are certainly obstacles in the way of reducing the elk to the rank of a servant to man; nevertheless they are not unsurmountable, after all." He suggested that, as in the case of the buck of the common deer, castration would effectually subdue the animal. He suggested further that if the social instinct is necessary to the complete domestication of an animal, no deer possesses it in a higher degree than the elk, which is often found in immense herds.<sup>b</sup>

One of the earliest successful attempts to domesticate the round-horned elk was made by Col. John Mercer, of Cedar Park, West River, Md. Colonel Mercer obtained his stock from St. Louis about seventy-five or eighty years ago. The animals were transported to Wheeling by water and thence to West River by way of Cumberland on foot. A few other breeders obtained stock from Colonel Mercer, among them Col. Joseph Tuley, of Millwood, Clarke County, Va.

Lorenzo Stratton, of Little Valley, Cattaraugus County, N. Y., began experiments with this species about sixty years ago. In a letter addressed to D. J. Browne, and dated January 12, 1859, he says:

The American elk, with all its claims to attention, is fast disappearing from the earth, with scarcely an effort for its preservation or domestication. By domestication I do not mean simply taming, but a course of intelligent breeding and protection. A series of experiments with this animal \* \* \* has furnished me with sufficient evidence to say confidently that this business may be made of great importance to the country. \* \* \* I have now a herd so gentle that a visitor at my farm would hardly imagine that their ancestors only three generations back were wild animals. \* \* \*

The facility for extending this business may easily be conceived. New York alone might support 100,000 elks on land where our domestic cattle could not subsist; furnishing an amount of venison almost incredible; while the adjoining State of Pennsylvania, to say nothing of others, might sustain a still larger number without encroaching upon an acre of land now used for stock rearing, or any other purpose connected with agriculture.<sup>c</sup>

<sup>a</sup> The Quadrupeds of North America, II, 92, 1851.

<sup>b</sup> Report U. S. Com. Patents (Agriculture) for 1851, p. 118, 1852.

<sup>c</sup> Report U. S. Com. of Patents (Agriculture) for 1858, p. 237, 1859.

At a meeting of the American Institute in New York January 6, 1862, Mr. Stratton gave a detailed account of his experience in domesticating the elk, in which he said, in part:

About eight years ago I had an opportunity to purchase two elks. I did so as a matter of curiosity and because I wished to see a few specimens of this forest-preserved, as my place is situated in the region where they used to roam in countless numbers. They did well and bred. I fenced off a few acres for them, and found after a while that I could certainly raise venison cheaper than my neighbors could raise beef. I devoted a large plat of stony, bushy land, unfit for any other purpose, to them. Since then I have succeeded in breeding 37 elk. I have had no accident of any kind amongst them, and they have fattened and bred regularly and have become quite domesticated. The does have been gentle and act like domestic cattle. The bucks have been also gentle until they were about 4 years old, when they have been difficult to manage in September and October, like a bull or stud-horse. In such cases I generally made venison of them. Excepting these instances, however, the animals are quite docile. The first fawn that I raised was very shy. He was in a lot of about 15 acres, and when I went to him he would flee from me, so that I could hardly get a sight at him. The next fawns raised were not so frightened when they saw me, and now when I go into the field the young fawns are like so many calves. My lot is fenced with common rails, 6 or 7 feet high, and there is no difficulty in keeping the animals within bounds. Frequently, when the fence may get down, they go out into a neighboring piece of woods, but as soon as anything startles them they run for their own field again, and feel safe only when they arrive there. They are not inclined to stray off. This lot in which they are confined they consider as their home, and chase off any dogs that may come upon it. In four generations, by kind treatment, I have, as I contend, not merely succeeded in taming them, but in domesticating them. They are as gentle as sheep that run wild. \* \* \*

\* \* \* The great profit in raising them, however, is for their meat. They live and fatten on useless land. Where the feeding ground is brush they will destroy it; but the grass will come up more profusely on this account in the summer; and it has the result of giving them better feed in the summer though not so good in the winter. I paid \$400 for the first pair I bought; I have bought 2 does since then, from which, with the first pair, I have raised my whole stock; I have been at various unnecessary expenses, from the fact that I did not know how to manage them; I can now raise elk cheaper than I can sheep; I have a 3-year-old buck, weighing 480 pounds, which has cost me less than any 3-year-old sheep I have got. I have been anxious to introduce them as common stock and have sold them for \$100 a pair. A great many are afraid to buy them, for fear they will get away and go wild again. They see me go into the field and all the flock come about me, and each one tries to get his nose into my pocket; but they say, "I don't believe I could do that." They think there is some Rarey secret about it. When I go into the lot, I generally carry a little handful of salt, or grain, or something which they like, which makes them come about me. \* \* \*

I think there is no better meat than that of the elk; it is richer and more juicy than the meat of the deer; I killed a 2-year-old doe this year which had had no fawn; she was very fat; I took 29 pounds of tallow from her, and she weighed 282 pounds dressed, the skin weighing 28 pounds.

At the same meeting Mr. Trimble stated that several years previously, while traveling over the prairie in Illinois, he had seen at a

house where he stopped a full-grown elk perfectly domesticated. There were no fences about and it never attempted to run away.<sup>a</sup>

The final outcome of the Stratton experiment at Little Valley was recorded in a communication to *Forest and Stream* by Mr. E. L. Stratton, of Grand View, Tenn., a brother of Lorenzo Stratton. He stated that so far as the experiment was carried it was a complete success. "Had there been a moderate amount of capital invested, with a larger territory of cheap mountain land added, and with close attention to the business, it would have been a profitable investment and doubtless would have shown handsome dividends. But when we decided to move South, the elk business had to be abandoned. Most of the stock on hand was bought by some foreigners and shipped by rail to New York, thence some to Italy and the rest to Germany, and three or four were slaughtered at home."<sup>b</sup>

In 1887 T. D. Kellogg, of Whitestone, Long Island, contributed to the *New York Herald* an interesting account of his observations on domesticating the wapiti, made when a pioneer in northwestern Iowa in the fifties. Mr. Kellogg said that at that time elk roamed over all the plains of that part of Iowa, but already in diminishing numbers. In the spring when a settler had killed a doe elk he would occasionally take home a suckling fawn in his arms and bring it up by hand. Two settlers whom he knew well had each an elk thus domesticated, and several similar instances came to his knowledge. These settlers had no inclosure except a small garden patch, from which stock was excluded by a rude fence.

The tame elk, let loose upon the open prairie, were at full liberty, and although born in a wild state they never joined a passing herd nor roamed far from home. They gave no trouble by getting into the garden or injuring the fence. They were less timid than sheep, although not so familiar as dogs. "Probably no animal in existence," says Mr. Kellogg, "is naturally fitted to take so kindly to domestication as this noble creature, so rapidly disappearing from the face of the earth."<sup>c</sup>

Judge John D. Caton, of Illinois, who contributed so much to our knowledge of the deer family and of their susceptibility to domestication, seems to have been unfortunate in having inclosures poorly adapted to deer. He believed that his pastures contained some kind of vegetable food that was harmful to most of the species, but his elk were always healthy. Writing in 1880, Judge Caton said:

My elk continue to do well and are so prolific that I have had repeatedly to reduce their numbers and would be glad now to dispose of at least 80. I

<sup>a</sup> *Trans. Am. Institute* for 1861-62, pp. 220-223, 1862.

<sup>b</sup> *Forest and Stream*, XLVIII, 445, June 5, 1897.

<sup>c</sup> *The American Field*, XXVIII, 126, August 6, 1887.

have on an average about one old buck a year killed in battle and sometimes another by some casualty, but all appear healthy. Mine grow very large and of all the Cervidæ they seem best adapted to domestication.<sup>a</sup>

With few exceptions former attempts to rear elk were made by men who were wealthy and actuated only by a desire to possess or to preserve the animals. Care of them was left to servants. The bucks remained uncastrated until they became old and unmanageable, when the serious problem of caring for them soon outweighed the novelty of their possession, and the experiments were abandoned. This will account for the failure of many of the herds that were founded a half century or more ago.

But these breeders of the elk have not been without successors, and at present there are small herds of elk under private ownership in many places in the United States. The Biological Survey has recently opened communication with owners of herds of elk and deer, for the purpose of learning their experience in rearing the animals and obtaining their opinions as to the feasibility of making the business profitable. Extracts from recent correspondence referring to the wapiti, or elk, follow:

Joshua Hill, of Pontiac, Mich., wrote, October 12, 1907, that he has elk and bison in his preserve of 300 acres. He finds the sale of elk meat slow, but thinks that, if properly pushed, the business of growing it would pay well. In his opinion the elk would be more profitable than deer, since the animals are larger and the venison better. He has heard of elk meat bringing 50 cents to \$1 per pound.

Isaac A. Bonine, of Niles, Mich., wrote, under date of October 14, 1907, stating that he had been breeding both the elk and deer for about thirty-five years. He said: "We find that deer are not so hardy as elk and require more care. Elk require less care than the domestic animals, while deer are even more delicate. Deer should have a greater variety of food than elk. Elk winter well on hay and corn fodder with a little grain, and they live and thrive during summer months on blue grass. Deer will live on the foods mentioned here for elk, but they should have vegetables also. They require an open shed or shelter of some sort during winter; an elk requires none. The growing of both elk and deer for park purposes may be made profitable."

J. W. Gilbert, of Friend, Nebr., states (March 17, 1908) that he has been growing deer and elk for seventeen years. The deer have not always done well, but he now has a healthy herd of about 30 head. The elk have increased and done well all the time. He has never had a barren cow elk. Mr. Gilbert's range of 75 acres is on the open prairie, and contains buffalo, deer, and elk.

F. J. Wilson, of Lewisburg, Ohio, began raising elk and deer a few years ago, with three head of each at first. He has not succeeded so

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<sup>a</sup>American Naturalist, XIV, 396, April, 1880.

well with deer as with the elk. Deer require a higher fence and more care. The elk do well on hay, corn fodder, and other rough feed; if they escape from an inclosure they can be driven back like cattle. Mr. Wilson paid \$165 for 2 adult elk and a fawn. He has sold \$300 worth of stock, and, in 1908, had a herd of 12 head, worth \$1,000.

The experience of Carl Tielenius with his herd at Mount Pocono, Pa., is less satisfactory. He began about the year 1890 with 26 head of 2-year-old elk, 22 of which were cows. The first year they produced 23 calves, and in the following four years 22, 18, 16, and 12, respectively. In later years with about 80 cows the number of calves has ranged from 5 to 10 per year. The herd is healthy, but reproduction is deficient in spite of the infusion of new blood by the introduction of bulls from the Whitney herd. It is possible that, as Judge Caton suspected to be the trouble in his herd, the bulls at Mount Pocono exhaust themselves by much fighting before the rut begins.

#### ELK IN THE OZARK MOUNTAINS.

Col. W. C. Wetmore, of St. Louis, writes under date of April 20, 1908, that the St. Louis Park and Agricultural Company, of which he is a member, owns several thousand acres of land in Taney County, Mo. The land is in the Ozark Mountains and the ground rough and hilly, though well watered. A little of the upland and some of the valleys are tillable, and corn and oats are grown in the former and corn and alfalfa in the latter—enough to feed the game when snow prevents their finding their ordinary food. The preserve is surrounded with an 8-foot wire fence, and in it are now about 400 elk and 1,000 deer.

Colonel Wetmore writes further:

They are hearty and healthy and do well in every way and at all times are fat and marketable. I am thoroughly convinced that the raising of both elk and deer can be made very profitable where the ground, water, and other conditions are favorable. Deer increase very rapidly, as a doe usually drops twins after she is three years old. Elk do not increase so rapidly, cow elk dropping a calf every other year, but they are hardy, and with an experience of over twenty years I have not known one to die of natural causes. \* \* \* I am a lover of all wild game, particularly deer and elk, and I hope you will be successful in interesting people in propagating them. Give them plenty of room to run in and they will do well.

George W. Russ, of Eureka Springs, Ark., has a herd of 93 elk (1909). They have ample range in the Ozarks on rough land covered with hardwood forest and abundant underbrush. He reports that the animals improve the forest by clearing out part of the thicket. Fully 90 per cent of the females produce healthy young, and Mr. Russ thinks he could make the business of growing elk for market profitable if the law would permit him to kill and export the meat.

He has an offer of 40 cents a pound for the dressed carcasses in St. Louis. If, as he claims, he can produce elk meat, cheaper than beef, pork, or mutton, this should be a remunerative price. He thinks that large areas in the Alleghenies and Ozarks not now utilized could be economically adapted to produce venison for sale, and he regards the American elk as especially suited for forest grazing.

Mr. Russ, in a letter dated Eureka Springs, Ark., March 7, 1908, sent the Department of Agriculture, through H. N. Vinall, Bureau of Plant Industry, the following answers to the several questions propounded:

Question 1. How many acres per elk of forest land is needed for best results?

Answer. Much depends upon the character of the forest land. In this section of the Ozark Mountains an average of 5 acres to the head. In other sections a larger area will be necessary. The larger the area the better the results. One hundred elk will fare better in a 500-acre inclosure than one elk confined on 5 acres.

Question 2. Would it be possible for individuals to raise elk under grazing permits in large tracts like the national forests without fencing, by some method of feeding in a certain place or by herding?

Answer. We think it possible to raise elk by individuals having permits in the national forests, by a system of feeding in certain places, thereby locating these animals on the range best fitted for them, and by loose herding by well-trained men familiar with their habits. But there are so many contingencies to be reckoned with on an open range that in our opinion it would be far preferable to fence.

Question 3. What is the cost per mile in forest land of an elk fence?

Answer. Again, much depends on distance from railroad, cost of labor, etc.; but ordinarily where posts and stays cost nothing but the making of them a good elk fence can be built for about \$200 per mile.

Question 4. Will the elk do any considerable damage to a forest in restricting the growth of young trees of valuable species?

Answer. Elk will feed on buds and leaves 8 feet above the ground, and any growth up to or under this is liable to be eliminated, depending upon the amount of such food. Unless the range is very much restricted they will not eat the bark from trees, neither will they resort to any species of evergreen. (Pl. IV.)

Question 5. What has been the per cent of increase in your herd under domestication?

Answer. The increase in elk under domestication is equal to that of cattle.

Question 6. What is the average weight of an adult male? Of a female?

Answer. Male, 700 to 1,000 pounds; female, 600 to 800 pounds.

Question 7. Will they not give a greater per cent of dressed meat than cattle?

Answer. Yes; but owing to the game laws our experience has been limited to a few animals. The per cent of dressed meat is much more.



ELK IN NEW PASTURE, NEAR EUREKA SPRINGS, ARK.



ELK PARK IN THE OZARKS, SHOWING ELIMINATION OF UNDERBRUSH.





**Question 8.** Is there at this time, or would there be in case the laws were revised, any general demand for elk meat? At what price?

**Answer.** In answer to this question, we can be guided only by the very limited demand, owing to the law prohibiting the sale of elk meat. We do, however, receive orders from parties not familiar with the law, and letters from many asking us if we are permitted to sell. From the fact that as high as \$1.50 per pound has been paid for this meat in New York City and Canada, and that the best hotels and restaurants pronounce it the finest of all the meats of mammals, we are of the opinion that if the laws were such that domesticated elk meat could be furnished it would be many years before the supply would make the price reasonable compared with other meats.

**Question 9.** What price per pound would you consider necessary to make the production of elk meat profitable?

**Answer.** Elk meat can be produced in many sections of this country for less cost per pound than beef, mutton, or pork.

**Question 10.** What laws, state or national, at present interfere with the production and sale of elk meat? What are your recommendations for revising these laws?

**Answer.** The remedy to the state and national laws is very simple, and at the same time just and equitable. By simply adding or inserting the word "wild" before the name of the animal protected. To guard against abuses, a certificate from the owner of domesticated animals should follow them, and proper penalties should be imposed for any violation of the laws.

**Question 11.** Would the elk be adapted for browsing in the Appalachian forests from Pennsylvania south to Georgia?

**Answer.** Yes; I am quite familiar with the Appalachian range, and consider it ideal.

**Question 12.** Are they as useful as goats in clearing out underbrush? Is it best to use both goats and elk?

**Answer.** They are more useful, as they will browse as low as goats and twice as high. I would earnestly recommend the use of both goats and elk for clearing up brushy land and fitting it for tame grasses. Elk and goats get along well in the same inclosure.

**Question 13.** What area will they clear up per year in your section? Keep cleared?

**Answer.** So much depends on the amount of underbrush as to the average amount elk and goats will keep cleared. The conditions in a mountainous country are much more diversified than in a level one, the growth of underbrush and timber often changing radically in a fourth of a mile. The average conditions in this range of mountains can only be estimated approximately. Our experience has taught us that to get the best results, after stocking with elk and goats, it is best to wait one year before seeding, then continue with elk and goats two years more; when, if properly seeded and pastured, an open woodland pasture of tame grasses will be obtained (Plate V). To accomplish this, our estimate would be an average of one elk and two goats to 5 acres. When the underbrush and weeds have been eliminated by elk and goats, they will be very slow in coming in again. The life has been destroyed by the continued browsing on bud and leaf, and not only is the stem dead but the root also. The

perennial weeds have been treated the same way. Those coming from seed must come from outside the fence, and will find the tame grasses in possession. Elk and goats fed on the falling leaves in the fall, thus lessening the covering of grasses. Tame grasses will not thrive under a thick coating of dead leaves.

Question 14. Is the forest open enough after their work to permit the growth of grass?

Answer. Elk and goats do not open up dense forests, except undergrowth. It is necessary to have considerable light and sun for the growing of tame grasses.

Question 15. After the forest land has been cleared and seeded to tame grass, could sheep be grazed in the same lot as the elk?

Answer. In reply to this question, we answer from long experience that cattle, sheep, and goats can be grazed in the same lots with elk, providing, however, that the lots or inclosures are not small—the larger the area the better; and we know of no more appropriate place to call attention to the great benefit of a few elk in the same pasture with sheep or goats. An elk is the natural enemy of dogs and wolves. We suffered great losses to our flocks until we learned this fact; since then we have had no loss from that cause. A few elk in a thousand-acre pasture will absolutely protect the flocks therein. Our own dogs are so well aware of the danger in our elk park that they can not be induced to enter it.

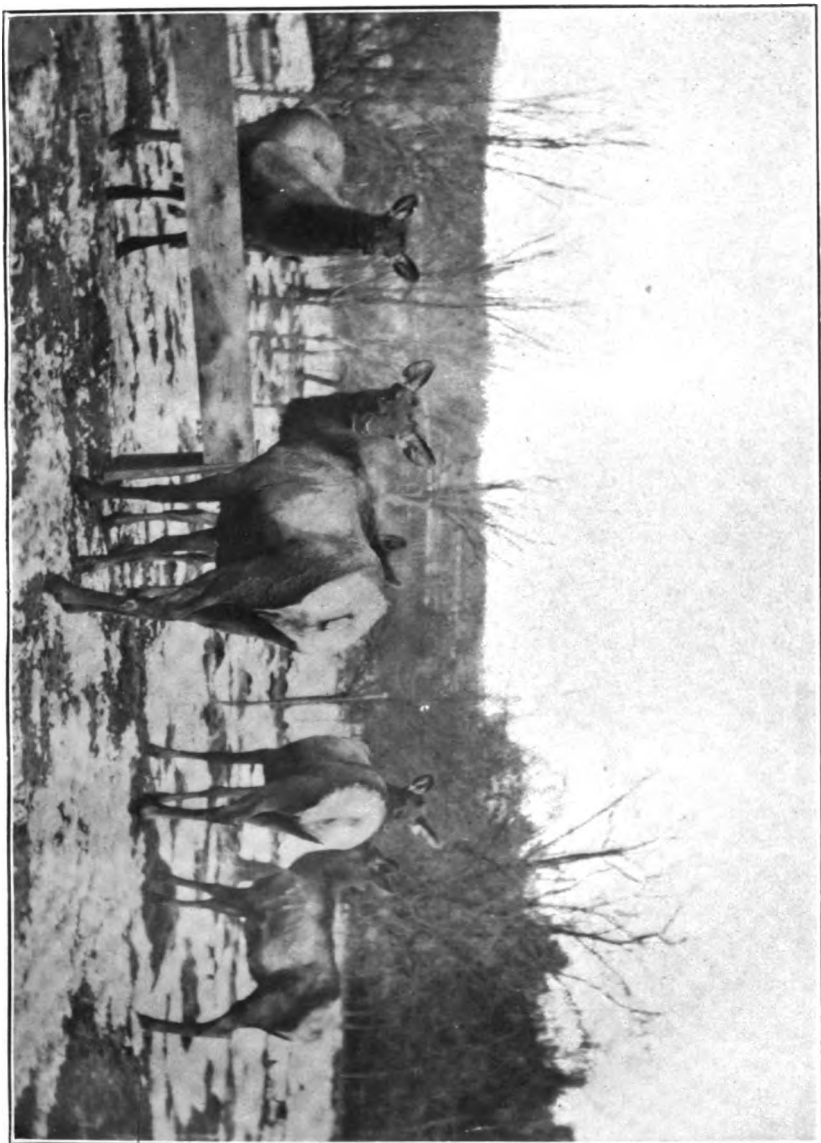
In your note you invite us to suggest any other points not covered by your questions. We think of nothing but feed and shelter. Nature has provided the elk with a winter coat of hair, which is in itself ample protection from any weather conditions, and which makes artificial protection unnecessary. All that is needed is feed, and on account of their browsing on that which is already in our hills and low mountains but little provision is needed. Like cattle, they are fond of grain and can be fattened on it, but may be kept in good condition during the winter on very little roughness. To be more explicit, one-half the ration per pound required for cattle will do for elk. We have opinions about caring for and domesticating the wild elk, saving to the nation what yet remains, and using them as a nucleus for general domestication and distribution. These views we will gladly furnish if desired.

#### MANAGEMENT OF ELK IN INCLOSURES.

The experience of Mr. Stratton at Little Valley, N. Y., recounted in the preceding pages, gives an excellent foundation for practice in developing a true domesticity in the wapiti; but for economic reasons it may not always be possible for the raiser of the elk to adopt the same methods. He may wish to grow the animals for venison only and on large preserves where the calves can not be tamed when young. But when the elk is grown for stocking parks and private preserves, the tamer the herd the easier will it be to handle and ship the stock.

#### RANGE.

The natural food supply is an important consideration in choosing a range for the elk. While elk have done well in blue-grass pasture and on the prairie grasses alone, they do far better on preserves



TAME ELK ON INDIAN ROCK GAME PRESERVE, OWNED BY C. D. RICHARDSON, WEST BROOKFIELD, MASS.



which have a variety of food—grasses, bushes, and trees. Rough lands well watered by streams and having a considerable proportion of forested area are best adapted to their wants. On an average such lands will support about the same number of elk as of cattle on the same area without impairing the range. There should be thickets enough to furnish winter browse for the animals. A supply of winter forage of other kinds will prevent the too rapid destruction of shrubbery in thickets.

#### FOOD.

Except in times of snow, elk will keep in excellent condition on ordinary grass pasture, but a system of management which regularly furnishes other food to the animals will be found better. For winter, hay and corn fodder furnish excellent forage; but alfalfa hay has proved to be the most satisfactory dry food that can be given to either elk or deer. A little oats or corn, whole or chopped, may be fed each day. Elk are fond of corn, and feeding corn and salt affords the best opportunities for winning confidence of the animals and taming them. Salt should be furnished liberally to all deer kept in inclosures. Running water, although not essential, is of great importance in maintaining elk in good condition. (Plate VI shows a small herd of elk at feeding place in winter.)

#### FENCE.

Elk are not nervous like the common deer and seldom jump an ordinary fence. A fence 5 feet in height is usually sufficient to confine elk, and Henry Binning, of Cora, Wyo., thinks a 4-foot woven-wire fence is ample. When they escape from an inclosure in which they have been fed they usually return of their own accord. Some herds may be driven like ordinary cattle. A small inclosure for a vicious bull elk should have a strong fence, 7 or 8 feet high. Mr. Russ tells us that where lumber for posts is cheap a good elk fence can be built for \$200 a mile, but the actual cost will, of course, vary greatly, according to style, cost of labor, nearness to market, and other circumstances.

#### COST OF STOCK.

The cost of stocking an elk preserve is not great. Young elk in perfect condition may be bought for \$100 per head or less. A few years ago Mr. Wilson, of Lewisburg, Ohio, paid \$165 for 3 head. A Michigan breeder recently offered a dozen head, all fine specimens, but age and sex not given, for \$500. This is, of course, a low price, not more than cattle would bring, and less than the venison would be worth if they could be sold in that form. The price of such stock is determined by the law of supply and demand, and as long as the

present restrictions on the sale of deer and elk are maintained, low prices are likely to prevail. Live elk sold at forced sale have been known to net the owners less than \$25 a head, but conditions would soon change if the laws concerning the sale and shipment of venison were generally made favorable for producing it in preserves. The demand for breeding stock would grow and increase the cost of starting, as well as the returns from the business.<sup>a</sup>

#### VICIOUSNESS OF THE MALE ELK.

Notwithstanding the viciousness of the male elk in the rutting season, he is ordinarily docile, probably more so than the buck of the common deer. Male elk have frequently been trained to harness and driven in public. Lorenzo Stratton trained a pair to harness and began exhibiting them at the Cattaraugus County (N. Y.) fair in 1853. They were a feature of the fair for several years, until he sold them in Europe. Exhibitions of trotting elks were common at county fairs in the Middle West a few years ago. W. H. Barnes, of Sioux City, Iowa, trained a pair and drove them harnessed to a light vehicle. He afterwards taught one of them to dive from a platform 30 feet high into a pool of water, and later he exhibited the animal in this act to admiring crowds in Europe.

The intractability of the male elk is not exceptional among deer kept in confinement, but his great size, his long, sharp-pointed antlers, and his thick skin, that renders him insensible to pain, make him much more formidable than the common deer. Several tragedies connected with attempts to domesticate the elk are matters of history. One recorded by Judge Caton occurred in his park.<sup>b</sup> Another took place at Bull City, Osborne County, Kans., October 12, 1879, in which Gen. H. C. Bull was instantly killed, two other men mortally wounded, and a fourth seriously injured by the attacks of an infuriated elk that had previously been regarded as tame and docile.

Deer and elk that are wild and unconfined will, under nearly all circumstances, run from man. When wounded they have been known to attack hunters; but it is unlikely that an uninjured wild bull elk would attack a human being even during the rut. The tame or partially tame animals that have become familiar with man are the ones to be feared. However, not all individuals become ill-tempered or vicious.

It should be borne in mind that all deer when confined in small inclosures and partly domesticated are likely to become dangerous

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<sup>a</sup> Since the above paragraph was written Farmers' Bulletin No. 330, Deer Farming in the United States, has been issued, and an unusual demand for deer and elk for breeding purposes has developed. Consequently prices are considerably higher.

<sup>b</sup> The Antelope and Deer of America, p. 285, 1877.

whether they have antlers or not. They can strike a vicious blow with the front feet; and a strong man, taken unawares, may easily be disabled or even killed by a doe of the common deer. To overcome the tendency to bad temper in deer would require many generations of breeding under domestication. It can not be quickly eradicated by petting the animals; on the contrary, it is usually increased by overfamiliarity. Children and strangers should be excluded from parks and paddocks that contain deer known to be vicious. Special precautions should be taken during the rut and when does have very young fawns. Persons with whom the animals are familiar should be constantly on the alert against surprise. In the rutting season no adult male deer or elk, however mild he may be at other times, should be trusted.

The remedy for viciousness in the male deer is castration. This makes the animal docile. It is unsafe to keep an uncastrated male elk over 4 years old, except in a strongly fenced inclosure. If the operation is performed when the horns are fully developed, they will be shed at the usual time and a new pair will take their place, but will not fully mature nor lose the velvet.

Another effect of castration is improvement in the quality of the meat, just as in the production of beef, pork, and mutton. Venison grown in preserves under a system in which all the male animals intended for slaughter are castrated should be uniformly of the highest quality, far superior to that obtained in the wild state during the usual open season for hunting, which comes during the rut or soon after. This is of great importance in fixing the final status of venison grown in private preserves.

#### THE ELK AS AN ENEMY OF WOLVES AND DOGS.

The statement by Mr. Russ in his report on raising the elk in the Ozarks, to the effect that elk are enemies of dogs and wolves, is of more than passing interest. Judge Caton reported a similar animosity of his elk toward dogs, and stated that the does always led in the chase of dogs that got into the elk park. If it is true that these animals when unhampered by deep snow will attack and vanquish dogs and wolves and thus help to protect domestic animals grazing in the same pastures, a knowledge of the fact may prove useful to stockmen and especially to sheep growers. It should be of great advantage in changing from a system of herding to the use of fenced pastures for flocks.

It is doubtful whether the enmity of elk for dogs and wolves extends to the animals outside of fenced pastures. Ex-President Roosevelt in *Outdoor Pastimes of an American Hunter* reports having seen a coyote walking unnoticed among a herd of elk in Yellow-

stone National Park. Thomas Blagden, of Washington, D. C., informs the writer that elk taken from the Whitney preserve to Upper Saranac Lake in the Adirondacks always ran from barking dogs, and were frequently chased from the grounds of cottages near Saranac Inn by this means; but possibly the presence of men with the dogs had much to do with the fleeing of the elk.

### THE WHITETAIL, OR VIRGINIA DEER.

Since the whitetail is the most widely distributed of American Cervidæ, there can be no question of its adaptability to nearly all sections of the United States. Testimony as to its hardiness in parks and preserves is not so unanimous as in case of the wapiti; but the general opinion of breeders is that with suitable range, plenty of good water, and reasonable care in winter the business of raising the animals for stocking parks and for venison may be made as profitable as any other live-stock industry. It has the advantage that land unsuited for cattle may be utilized in raising deer.

Advocates of the Angora goat industry state that in the United States there are 250,000,000 acres of land not suited for tillage nor as pasture for horses, cattle, or sheep, which are well adapted to goats. Much of this land is equally well suited to deer and elk, which do less injury than goats to the forest cover.

Probably experiments in domestication have oftener been made with white-tailed deer than with any other North American mammal. The great beauty of the young fawns appealed to the earliest settlers, who soon learned how easily they could be tamed and how readily they attached themselves to those who fed them. The danger from these same pets, especially the males, when grown, was soon learned also. Thus the experiment usually ended with the maturity of the subject, which was soon disposed of or banished to a safe inclosure.

Deer parks were established in early times on a considerable number of the large estates, or manors, in Maryland, Virginia, and New York. At least one of those in Maryland dated back to the seventeenth century. The early parks seem to have been generally stocked with fallow deer brought from England. The Revolutionary struggle marked the destruction of nearly all the private deer preserves; but a few of them, especially in Maryland, continued in existence, and others were restocked after the end of the war. As few fallow deer were imported later, and it was generally believed that our native deer were unsuited for park purposes, private preserves did not become numerous. The common opinion as to native deer was expressed by the eminent authority on landscape gardening, A. J. Downing, who in 1852 wrote as follows:

All attempts to render our native deer really tame on home grounds have, so far as we know, failed among us, though with patience the thing may

doubtless be done. It would be well worth while to import the finer breeds of English deer, which are thoroughly domesticated in their habits and the most beautiful objects for a park.<sup>a</sup>

When the above was written, both Virginia deer and American elk were doing well in a number of parks in the United States, and had been acclimatized in parks in England and on the Continent, where they were almost as tame and fully as hardy as the fallow deer. That these facts should have escaped the notice of Mr. Downing seems remarkable.

The American Turf Register and Sporting Magazine for April, 1831, contains a letter from W. E., of Roanoke, N. C., in which he gave interesting details concerning his herd of domesticated deer. These he claimed were so tame that his hounds readily distinguished their track from those of wild deer that occasionally visited the park. He wrote in part:

One-half of my park being a forest, the deer shelter themselves in it during bad weather, and they dislike cold so much that frequently they will not leave their shelter to come to the troughs, which are in an unprotected part of the inclosure. To prevent fights there should be at least one trough for every two deer. I feed them on Indian meal, having found by experience that raw corn is apt to swell and kill them. One quart of meal per day is sufficient to keep a deer always fat. They are very fond of sweet potatoes, which they will eat though half rotten; they like the leaves but not the root of turnips.

Deer are very prolific. I have never owned but two does that had less than two fawns at a birth. A friend of mine owned a doe that had three fawns three years in succession and they were all females. \* \* \*

I have known but one doe to have fawns before she was 2 years old. \* \* \* They generally bring forth from the 1st to the 20th of June. The earliest that I have known was the 18th of May and the latest the 12th of July. Should a doe die leaving fawns, one of the other does attends to the fawns as well as if they were her own. Just before the time for them to have young, I put them up in six-sided pens made of rails. The fawns at first are quite wild. I do not have them turned out of the pens before they are perfectly gentle.

The raising of deer for profit has seldom or never been undertaken in a systematic way in the United States. Breeders have stocked preserves with deer as game for private use or grown the animals in small inclosures for the pleasure of owning them. But the economic possibilities are now beginning to be apparent. Some who have abandoned the business for lack of proper range are yet convinced that it might be made profitable. From a mass of correspondence, the writer has selected the experiences which bear most upon economic results and upon the proper management of the animals in semidomestication.

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<sup>a</sup> Rural Essays, p. 174, 1854.

**EXPERIENCES OF BREEDERS.**

While hunting in the Adirondacks in 1874, Thomas Blagden, of Argyle, near Washington, D. C., captured a pair of fawns and took them to his home. In due time these deer bred and became the ancestors of several hundred head. In 1902 Mr. Blagden transferred 48 of his herd to his summer home at Saranac Inn, Upper Saranac Lake, in the Adirondacks. (Plate VII.) On account of insufficient range and food, both herds have been greatly reduced by sales, and the greater part of the Argyle herd has been destroyed by worthless dogs.

Mr. Blagden is confident that under proper conditions the business of raising deer may be made to pay well. In his own herd, by securing new bucks from time to time, he has carefully avoided continued inbreeding. His stock is vigorous and of the large size characteristic of the Adirondack and other northern deer. On this account they command an exceptionally high price, \$50 each for bucks and \$75 each for does. He feeds grain, using corn, and a mixture of bran and meal. During the summer as much wild food as possible is cut for the deer, which always care more for the rankest weeds than for the choicest grass. Of hays they prefer alfalfa to other kinds.

Mr. Blagden regards the water supply of a deer park as extremely important. Running water should be constantly accessible to the animals. He attributes the great winter mortality among wild deer in the Adirondacks entirely to the fact that all water courses are frozen solid, and to obtain water deer are forced to eat sleet-covered shrubbery, which, he thinks, poisons them.

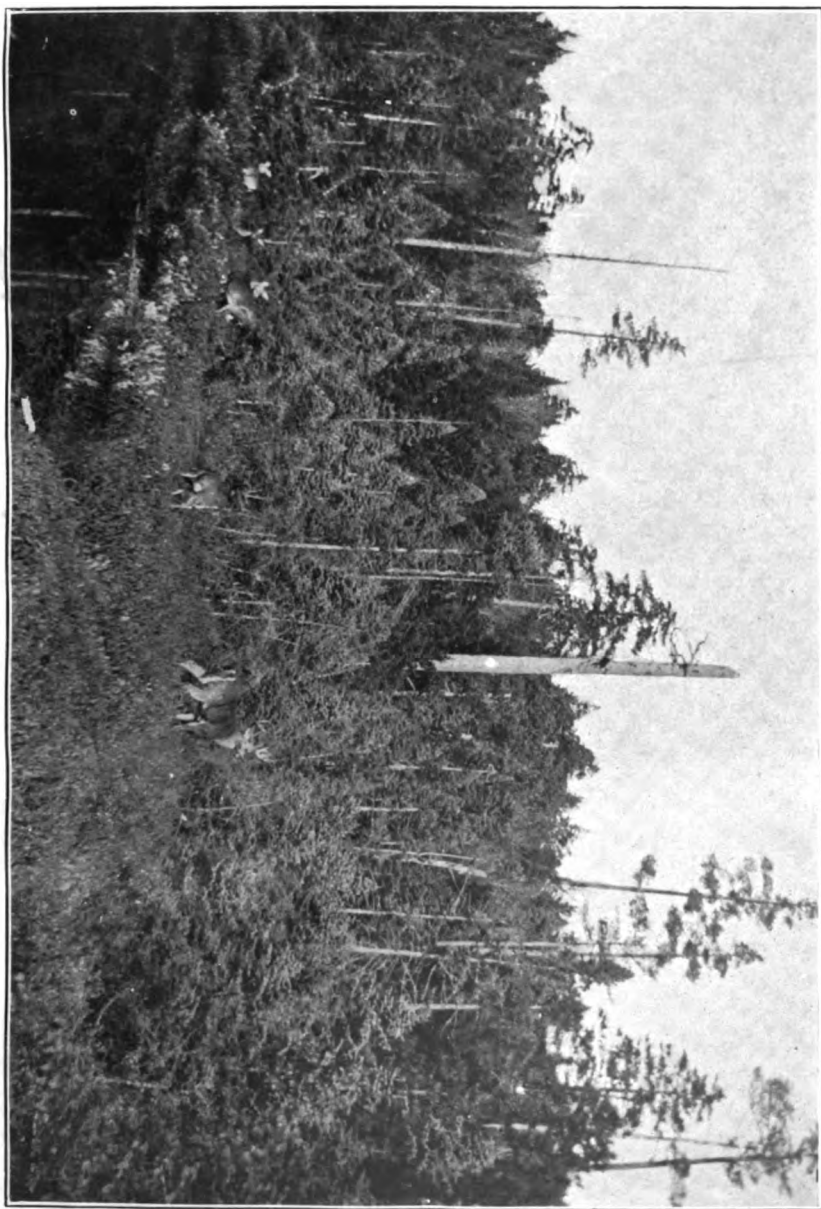
W. R. McKeen, of Terre Haute, Ind., has a large herd of deer on his stock farm near that city. The Sportsmen's Review quoted an account of this herd from an Indianapolis newspaper stating that it is one of the largest, if not the largest, herd of near-domesticated deer in the State. The herd was started nearly twenty years ago with about half a dozen animals and with no idea of profit. With the exception of a few dairy cows, no other stock is now kept on the farm. The demand for deer is fairly active. Each fall a considerable number are sold, and shortly before the Christmas holidays of 1906 between 30 and 40 were disposed of. The deer are sold to persons having parks of their own and to museums, menageries, and the like. There is also a demand each winter for venison. Altogether the sales keep the increase of the herd from overstocking the place.\*

Writing March 28, 1908, John W. Griggs, of Goodell, Iowa, states that he has been engaged in raising deer about fourteen years. Until two years ago he sold his surplus stock for parks, but since then has

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\* Sportsmen's Review, XXXII, 286, Sept. 14, 1907.

VIRGINIA DEER IN PARK BELONGING TO THOMAS BLAGDEN, SARANAC INN, UPPER SARANAC, N. Y.





disposed of about half of it for venison. For park purposes he gets \$20 to \$30 a head; when fattened for venison they bring \$20 to \$35 a head. The animals do well in captivity. Mr. Griggs says further: "In raising a large herd the park should be divided into two or three lots, and one plowed each year and sown to red clover, mustard, rape, and seeds of different kinds of weeds. Blue grass and timothy are useless. Corn is the principal grain I feed. I feed it winter and summer. In winter I feed also clover hay, oat straw, and weedy wild hay. Deer when rightly handled are very prolific, and from 50 does one can count on 75 fawns. Deer can be raised profitably for venison—very profitably until overdone—but I would not advise one to go into it on a large scale without previous experience with deer."

Charles Goodnight, of Goodnight, Tex., writing March 26, 1908, states that he kept deer and elk on his plains pastures for a number of years, until he became convinced that his ranch was unsuited to browsing or partly browsing animals. He says: "With a properly selected place, the raising of these animals is not only practicable but very profitable. I should select a rough, broken piece of country with some prairie and glades, covered with as great a variety of shrubbery as possible. Deer will not eat ordinary grass if they can help it, but will eat wild rye and other kinds of soft grasses. With a properly selected place they are of very little expense after the pasture is fenced."

R. H. Harris, of Clarksville, Tex., on January 16, 1908, wrote that he had been engaged in raising Virginia deer for several years, and thinks that the business is admirably adapted for the profitable investment of capital. The Virginia deer is suited to almost every section of the United States. It is prolific, each doe usually producing twins. These grow very rapidly, and become the most beautiful, graceful, and healthy animals known. The demand for venison and deerskins is unlimited, the flesh being very high priced in city restaurants and cafés.

"No other meat," says Mr. Harris, "is equal to venison as a diet for the sick, it being easily digested and agreeing with the most delicate stomachs. Deer are easily tamed; the wildest fawn, if taken from the herd when young, will in a few hours become as gentle as a pet dog. I have for several years been raising them in large numbers. They run at will in woodlands and fields, are never handled, but fed occasionally, and are as gentle as a common herd of cattle. They are easily and cheaply raised and seldom, if ever, die from natural causes. After years of practical experience, I unhesitatingly state that the raising of deer is in profitableness second only to the raising of cattle.

"The cost of feeding deer averages about one-half cent each per day. They feed on all kinds of vegetables, buds, and leaves of trees,

growing wheat, clover, peas, barley, oats, etc. Cotton seed is also a very cheap and satisfactory food for them. They eat also corn, bran, chops, fruit, and in fact anything that man or beast will eat, except dry hay. They live from twenty to twenty-five years. They are easily confined by a woven wire or barbed wire fence, 6½ feet in height."

#### A DOMESTICATED HERD OF DEER.

C. H. Roseberry, of Stella, Mo., writes under date of January 13, 1908, as follows:

My experience in breeding the common or Virginia deer covers a period of seventeen years, beginning in March, 1891, when as a boy of 16 I built a small inclosure of 1½ acres to confine a single doe that was captured as a fawn in the neighboring forest. A buck and other does were secured from year to year until in 1900 by purchase and natural increase my herd numbered 25 head of all ages.

From 1891 to 1901 I lost every year from disease an average of 20 per cent. The climax came in the drought year of 1901, when my loss was 50 per cent from the disease known as "black tongue." I am convinced that, as with cholera in swine, individuals recovering from this disease are immune from further attack. Apparently all of my herd were afflicted. The survivors and their progeny constitute my present breeding stock. I have made no purchases since 1901, nor have I suffered any loss from disease.

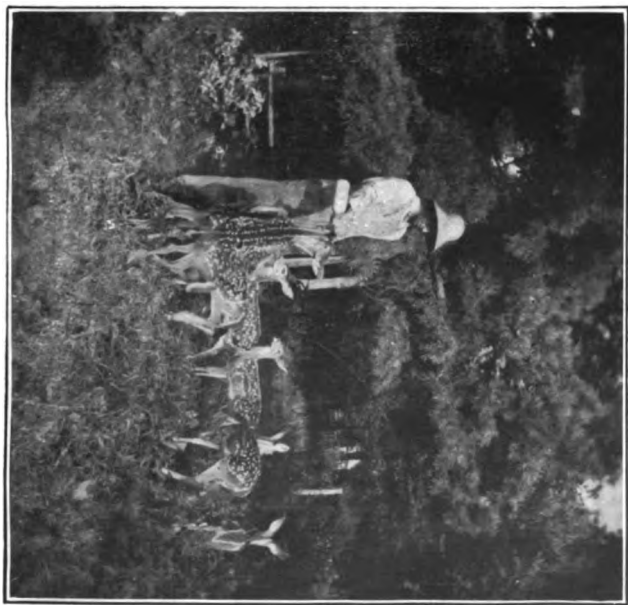
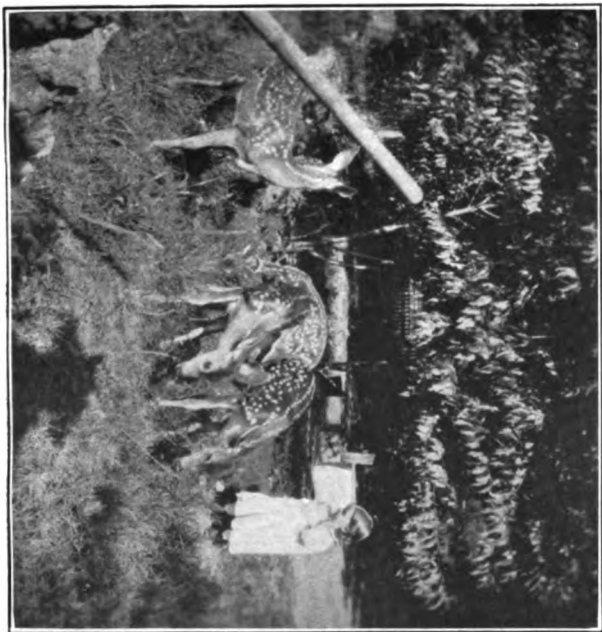
For the last seven years my herd has averaged 70 per cent increase, all of which I have sold at satisfactory prices. I began selling at \$20 per pair of fawns at 4 months of age and \$30 per pair of adults. I now get \$40 and \$60, respectively. I sell almost exclusively for pets and for propagating purposes, although a few surplus bucks have been sold for venison, averaging me 15 cents per pound gross weight.

If we except the goat, I know of no domestic animal common to the farm that requires so little feed and attention as the deer. My herd has a range of only 15 acres, two-thirds of which is set to white clover, blue grass, and orchard grass. I provide also a small plat of wheat or rye for winter pasture. With the above provision in this latitude no feed is required between April 15 and November 15. During the rest of the year a ration of corn, bran, or other mill feed, somewhat smaller than that required for sheep, in connection with a stack of clover or pea hay to which they have free access, is sufficient to keep them in good condition. Deer eat with relish nearly all of the common coarse weeds, and for clearing land of brush they are, I think, second only to the common goat.

Probably the greatest expense connected with the business of raising deer is the fencing. Another item of trouble and expense when the animals are raised for pets, requiring that they be handled and shipped alive, is the fact that the fawns must be taken from the does when 10 days old and raised by hand on cow's milk. They are quite easily raised in this way, with but slight percentage of loss, but require frequent and careful attention for the first month. (Plate VIII.) When they are allowed to run with the does their natural wildness can not be overcome, no matter how gentle the does may be. (Plate III, fig. 1.)

I have found the business profitable on the lines indicated. I believe they could be profitably bred for venison alone, certainly with less trouble and expense, since the fawns would be reared by the does and the trouble and expense of raising by hand eliminated.

FAWNS OF THE VIRGINIA DEER AT KENT DEER PARK, HOME OF C. H. ROSEBERRY, STELLA, MO.





My experience does not coincide with that of some other breeders in respect to the weakening of reproductive powers of deer by their confinement in parks.<sup>a</sup> I have no barren does. Usually they produce a single fawn at 2 years of age; afterwards twins, and, in rare cases, triplets.

#### INCREASE OF WHITE-TAILED DEER IN DOMESTICATION.

Early in 1900 a pet doe heavy with fawn was delivered at the Taney County, Mo., game preserve belonging to the St. Louis Park and Agricultural Company. The doe had been thoroughly domesticated, and, refusing to join the wild deer in the preserve, remained near the home of the tenant and under the immediate care of his family. In the spring of 1900 she gave birth to two fawns, both does, which became as gentle as the mother. In the spring of 1901 the old doe again dropped 2 fawns. In 1902 there was an increase of 4 fawns, each of the young of 1900 having given birth to a fawn. By the spring of 1905 the domestic herd had increased to 25 deer, all the increase of 1 pet doe.<sup>b</sup>

A herd of mule deer at Crawfordsville, Ind., has increased with almost equal rapidity. These deer belong to James F. Boots, and are kept in a 4-acre inclosure. Mr. Boots writes that in 1899 he brought a buck fawn from Colorado, and nearly four years later he secured 2 adult does. From this stock he has had fawns as follows: 1904, 4; 1905, 4; 1906, 8; 1907, 10; 1908, 5; 1909, 10; from the 5 does then kept. All were raised except those born in 1908, the loss of which was attributed to excessive heat.

#### DEER HYBRIDS.

However undesirable hybrids among wild animals may be regarded by naturalists, the production of them among domesticated or semi-domesticated species is of great economic importance. The experiments of breeders in hybridizing deer, aside from the apparent value of the results obtained, are highly interesting. Mention has already been made of hybrids between the American wapiti and the red deer as well as the Altai wapiti. The first of these crosses was obtained by the Prince of Pless, in Silesia, about a half century ago.

Judge Caton made experiments at Ottawa, Ill., and obtained a number of hybrids, the most important being those between the Virginia deer and the Acapulco deer (*Odocoileus toltecus*) and between the Virginia deer and the Ceylon deer (*Cervus axis*). These deer exhibited no natural tendency to breed together, but when the male of the exotic species was absent or accidentally lost he introduced the buck of the Virginia deer.

<sup>a</sup> Cf. Caton, J. D., *Antelope and Deer of North America*, p. 304, 1877.

<sup>b</sup> Second Annual Report Missouri Game and Fish Warden, p. 20, 1907.

John W. Griggs, of Goodell, Iowa, has succeeded in crossing the mule deer with several races of the whitetail. The hybrids were obtained by isolating the pairs in separate yards. As long as the different species or races are kept in a common pasture, each kind herds by itself and no sexual association between the different kinds takes place. Under such circumstance or in the wild state crosses are exceedingly rare. Mr. Griggs obtained his hybrids by placing a buck of the mule deer with whitetail does before the rut began, and the offspring proved to be highly satisfactory as to size and stamina, and also were perfectly fertile. As was to be expected, however, offspring in the second generation of hybrids varied much in form, size, and other characteristics, and on the whole were not so satisfactory as the first generation. He thinks that his hybrids with the mule deer have stronger constitutions than the Virginia deer and are less liable to disease.

Charles Goodnight, of Goodnight, Tex., writes that he crossed the mule deer with the white-tailed deer with great success, making a valuable and beautiful animal with greater size and better meat than the common deer. The hybrids were fertile also, and Mr. Goodnight would have continued his experiments further, but, having no shrubbery or trees within his range, he found it unsuited to deer and liberated his herd.

#### HABITS AND MANAGEMENT OF VIRGINIA DEER.

Deer are polygamous like cattle. The rutting season is in November, the period of gestation is 205 to 212 days (about seven months), and the fawns are born in May or June. The young does breed usually when about seventeen months old, and have but one fawn the first time; afterwards they commonly have twins. The fawns are spotted, and remain so until the hair is shed in the fall.

The white-tailed deer is even more a browsing animal than the elk; and yet it can and often does manage to get along in summer on grass alone. In a cultivated pasture it eats rank weeds and wild grasses in preference to timothy or blue grass. Observation of deer feeding in a pasture several hundred feet away is insufficient to determine accurately what they are eating. A writer in *The American Field* states that he often saw mule deer apparently eating grass in the Colorado parks, and he had no doubt that they did so until a hunter informed him that they would not eat grass unless they could obtain no other food. Afterwards he had a number of times examined the stomachs of deer he had killed, and only once found what was unmistakably grass.<sup>a</sup>

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<sup>a</sup> *American Field*. XXII, 600, Dec. 27, 1884.

The Biological Survey has examined a few stomachs of deer killed in the United States. A Columbia black-tailed deer taken in the Chemise Mountains, Mendocino County, Cal., had eaten acorns and an equal bulk of foliage, mostly willow leaves. A young deer of the same species taken on Mount Shasta, California, had grass in its stomach. Three individuals of the Arizona race of white-tailed deer (*Odocoileus virginianus couesi*), taken at different times, had eaten, respectively, leaves of the little blue live oak (*Quercus grisea*), with some flowers and flower stems of *Nolina lindheimeriana*; green foliage, seeds, berries, and the pods, beans, and leaves of *Acacia* sp.; and green leaves of *Thermopsis montana*, vetch, strawberry, geranium, *Senecio* (two species), aspen, and a flat green lichen—no trace of grass or acorns. A white-tailed deer killed in Minnesota in April had nothing but lichens in its stomach.

In captivity deer eat almost every kind of vegetation, including all sorts of garden stuff. They are fond of acorns, beechnuts, chestnuts, and other mast. Lily pads, fallen leaves, lichens, and mosses are freely eaten; so that, with plenty of range and an abundant variety of plants, there is little difficulty about food for deer. A good supply of running water must be provided, and the animals should have access to rock salt. If the browse and pasture are scant, some grain should be fed even in summer, and it is best to feed regularly in winter. Of the grains, corn is generally recommended; there is no waste in feeding it, as deer pick up every grain. Coarse hay full of weeds is preferable to timothy or other tame hays, except alfalfa. Of clover hay, deer usually pick out the dry flower heads greedily, but waste the other parts. In the northern half of the United States winter shelter should be provided for deer.

The practice of pasturing hogs in deer parks is objectionable, since they destroy nearly all the mast. For this reason the wild boar is unsuited for American game preserves intended for deer and wild turkeys.

#### VICIOUS BUCKS.

The dangerous character of some deer, especially the males, in semi-domestication has already been discussed. The whitetail is no exception. Charles C. Worthington, writing to the Biological Survey of his experience with vicious bucks, says:

The first serious difficulty I experienced, and one the gravity of which should not be lost sight of by anyone starting a preserve, was with the tame bucks at the rutting season. These bucks from being tame and docile would become at this season fierce and dangerous. They would attack anyone at sight, even a person on horseback or in a wagon. Some of the gamekeepers had narrow escapes from being killed; in one or two instances being seriously injured. A pedestrian's only chance for escape was to climb a tree. Those bucks which developed this ferocity had to be systematically hunted and shot on sight.

Those left were the ones that had not been originally tamed, and not being accustomed to the sight of man, had not courage enough to make an attack. My experience is that a wild buck, even in the rutting season, still retains his natural fear of man, and, except when wounded, is never dangerous.

Instances of fatalities from attacks of vicious bucks of the Virginia deer are not lacking. A rather recent one was the death of Herbert Bradley at Montclair, N. J., November 10, 1906. While working alone on his grounds, he was attacked by a pet deer and so badly wounded that he bled to death before aid could be obtained.

The remarks about castrating the elk apply as well to the common deer. A number of vigorous bucks, however, must form a part of any considerable herd, for a single buck can serve only a limited number of does. One buck for each ten or twelve does will probably be enough. New bucks should frequently be introduced to avoid in-breeding.

#### CAPTURING LIVE DEER FOR SHIPMENT.

In 1887 C. W. Marsh, of De Kalb, Ill., in a letter to *The American Field*, said:

Thirteen years ago this spring I fenced in a few acres of natural woodland with a bit of prairie adjoining my residence lot for deer; the fence was 8½ feet high and proportionately strong. I advertised for deer, and during the season got a buck from Sioux City, caught in Dakota; a doe from Kansas; another from Missouri; and still another from a gentleman in De Kalb, this last having been sent to him when a fawn from Arkansas. They were all red or Virginia deer, but showed considerable difference in size, form, and disposition; and they were all tame; that is, had been pets and would bear handling; hence had come quietly and unharmed in their cages. These began breeding at once, the does dropping two fawns generally. The young deer were as wild probably as any in the forest at first, but as the does were tame they also soon became quite tame, though not one has ever submitted to handling. They were rugged, hearty fellows, and in course of a few years I had a herd of over twenty. Occasionally I killed one for venison, and as they increased so fast I caught and gave a number to friends and sold a few. While the old does lived the young were easily caught, as the former would go into any cage or trap for food during the winter months and the latter would follow, and although they would struggle fiercely when caught, they gave up and quieted down as soon as hands were removed. None were lost in shipping. In due time the old does died, and all of my present herd except one buck were dropped by does that were bred in the park. Apparently each succeeding generation became wilder and more difficult to catch, and I have for some few years past thinned them out in the fall by shooting and marketing them. Still, they always answer my whistle and come around me for food. \* \* \*

They are hardy, active, and very shy of anything strange, but manifest strong attachment for home. Several times during these many years dogs have gotten into the park and run some of them out. When scared thus, nothing will stop them, and they will either go through or over any fence—they have frequently bounded over mine, 8½ feet high—but when out they will usually jump back again of their own volition, even though they had been off in the woods or about the park outside for weeks. In such instances they hung

around for a time seeking an easy entrance apparently (it is useless to try to drive them in), and failing in that they finally jumped over or smashed through the fence. When out they are very wild, but when they get in will come up for feed and be as tame and unconcerned as before.

As a culmination to the increasing wildness of his herd, Mr. Marsh found that in capturing and crating deer which he sold for stocking purposes he lost a large per cent as a result of exhaustion from their struggles.\* Mr. Blagden relates a like experience in shipping live deer to purchasers, but later he overcame the difficulty by an ingenious trapping device. Charles C. Worthington uses a similar trap at his Warren County (N. J.) preserve.

In a recent letter to the Biological Survey, Mr. Worthington describes his deer trap as follows:

As a demand exists for deer to be used for the restocking of state lands and for establishing private preserves, I, several years ago, began experiments in trapping them. It was well known that a wild deer caught in any small inclosure of wire will kill himself in his efforts to escape, but believing that he would not do this if the fence were made in such a way as to prevent his seeing through it, I constructed an oblong trap, about 20 feet wide and 30 feet deep, of boards 10 feet high, nailed closely together, so that nothing could be seen through them. A board door of the same height and running loosely in vertical grooves was fitted to one end, and opposite to it a narrow board passageway was built just high enough for a deer to enter and about 5 feet long; at the outer extremity of this passageway was placed a similar sliding door, big enough to close tightly the end of the passage. The main door is held open by a wire that extends several hundred feet to a blind, where the trapper stands concealed. When the snows are on the ground, this trap is baited with tempting food, which the deer finally enter the trap to secure. When it is found that they enter the trap without hesitation, a man stations himself on watch, and at such time as a number of deer are inside, drops the sliding door and imprisons them. They are left for a few hours until their first fright is somewhat allayed. Then crates, just large enough to hold one deer, and having only enough openings to supply sufficient ventilation, are placed, one at a time, in front of the smaller sliding door at the end of the passage. The crates are provided with a corresponding door. These being raised, the deer are made to enter the crates one at a time, and so are secured. The men, during this entire operation, remain concealed.

This form of trap has proved effective and satisfactory in every way. There have been caught in it during the last few years over 300 deer, which have been transferred to various localities throughout the country with a death rate of less than 4 per cent. The trapping operations have to be discontinued by the middle of February, owing to the does being then so heavy with fawn that any attempt to crate and transfer them is attended with too much risk.

The game commissioners of Pennsylvania and New Jersey have purchased numbers of these deer to be liberated in various parts of their respective States. The experiment of restocking districts from which these animals disappeared long ago has proven most successful and popular.

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\* American Field, XXVII, 295, 1887.

**WILD DEER IN PRIVATE PRESERVES.**

In many parts of the United States private preserves have been established by either individuals or associations and stocked with deer and other big game. Such enterprises have met opposition from both citizens and sportsmen, the latter being frequently ousted from favorite hunting grounds by the fencing and posting of such preserves. The feeling against large deer parks in America is in part a survival of an Old World prejudice against them, but in the main results from doubt of the wisdom of permitting large holdings of unproductive land. In a majority of the States private preserves are still subject to all the game laws of the State, so far as time and manner of hunting in them are concerned, and thus the owners are unable to reap the full economic advantage of their possession. While these conditions prevail, large game preserves are open to the objection that they are sources of wealth which are not fully utilized.

A few private preserves have been stocked with exotic game—red deer, wild boars, and the like—and in many of them large expenditures have been necessary to provide good sport. In some of the States the rights of owners of such preserves to the unrestricted use of the game within them is not clear, while such rights are clearly set forth or denied in the laws of others. As long as game within the preserve is comparatively scarce, owners will be content to use it in strict conformity to the hunting laws of the State. But when the game increases so as to overstock the preserve, or to become a source of revenue to the promoters, greater privileges will be demanded and will have to be granted, for grades of domesticity in deer and elk are not sharply drawn, and there is no difference, so far as ownership is concerned, between those raised in parks for venison and those produced in a fenced preserve for sport.

Full recognition of private ownership in game does not interfere with the right of the State so to regulate its disposal as not to jeopardize the preservation of wild game. Game regulations must be insisted upon, and the owners of private preserves will usually be as vigilant as anyone in helping to enforce them.

The increase of white-tailed deer, when protected within suitable large fenced preserves, is remarkably rapid, and there is no doubt as to success in propagating them under natural conditions as wild game. The experience of a large number of hunting clubs and individuals that have stocked preserves is favorable. In the ten years between 1892 and 1902 deer in Buckland Park, the Warren County, N. J., preserve belonging to Charles C. Worthington, increased from 19 to about 400 head, a number considered too large for the sustaining capacity of the park. The St. Louis Park and Agricultural Company have about 1,000 deer and 400 elk on their large preserve in Taney County, Mo. About six years ago the Otzinachson Rod and

Gun Club, of Clinton County, Pa., placed about 90 deer, mostly does, in their 4,000-acre park. These have multiplied to nearly 2,000 head, and a further increase of about 1,000 fawns was expected during the season of 1908. These experiences in stocking large preserves with deer, although highly successful, are probably not exceptional.

#### EFFECT ON GAME SUPPLY.

The effect of private preserves on the supply of game in the State should not be overlooked. While they may temporarily restrict the hunting privileges of a few citizens, ultimately they become a source of game supply secondary in importance only to state preserves. Already a number of private preserves have become overstocked, and game has escaped or been turned out to become the property of the people. Both deer and elk are said to have escaped from the Corbin preserve in New Hampshire and from the Whitney preserve in Massachusetts. The game in the well-stocked preserve of Dr. W. S. Webb in the Adirondacks became the property of the State when, in 1903, the owner demolished the fences which for many years had surrounded his 8,000-acre park.

Charles C. Worthington writes, May 21, 1908, that when, in 1902, the deer in his New Jersey preserve became too numerous to be supported by the acreage inclosed, several wide gates were left open for a few months. Few of the animals availed themselves of the opportunity to escape. Mr. Worthington says: "There was little incentive for them to leave the inclosure, and most of those that did probably returned at the first alarm, their instinct directing them to the inclosure as a protected, safe retreat. The few that remained outside have increased in numbers, until now the region round about for a radius of several miles is well stocked. While some complaint has been made by the farmers in the neighborhood that the deer destroy some of their grain, the general sentiment is in favor of having the laws for their protection rigidly enforced."

The success of private enterprise in propagating deer in inclosures is an object lesson for state game commissions and others, and suggests that the State should undertake similar work for the public. The establishment of game preserves on public lands of the State is a most important step in game preservation, especially if the lands are already stocked with wild deer. But the further introduction of breeding animals will hasten multiplication, until the preserve becomes a source of game supply for the surrounding territory. While more national preserves are needed, a system of state preserves is all-important. Those already established in Pennsylvania and other States have proved highly useful, and it may truthfully be said that in every country that has tried them, public game preserves have been instrumental in increasing the game supply.

### GAME PROPAGATION AND GAME LAWS.

The chief obstacle to profitable game propagation in the United States lies in the restrictive character of state laws affecting the killing, sale, and transportation of game. Many of the States, following precedent, lay down the broad rule that all the game in the State, whether resident or migratory, is the property of the State. A few of them, notably Nebraska, North Dakota, and Tennessee, except such game animals as are "under private ownership legally acquired." A few others encourage private ownership by providing means by which wild animals may be captured for domestication. Generally, where private ownership of game is recognized by law, the right to kill such game is granted, but the owner is hampered by the same regulations as to season, sale, and shipment that apply to wild game. One by one, however, state legislatures are coming to recognize the interests of game propagators and to modify the game laws to meet the changed view.

#### TRANSPORTATION OF LIVE DEER.

Except in a few States that provide for the capture of wild deer under permits, the only source of stock for private preserves is the animals already in captivity. Hitherto the shipment of live deer and elk from private preserves has often been permitted because game wardens and others interested could see no advantage from interfering, notwithstanding that a literal construction of the law in many States would absolutely forbid such shipments. Pennsylvania is one of the few States that give owners of private deer preserves the positive right to sell and ship deer or fawns at any time for propagating purposes.

#### TRANSPORTATION OF VENISON.

Under the license system and within specified limitations, some of the States permit the holder of a hunting license to ship venison lawfully killed to his home within or without the State. The general transportation of venison, as well as its export out of the State in which it was killed, is usually forbidden. Only a few States permit the export of deer, and two of them—Delaware and Ohio—have no deer, so that the animals are not mentioned in recent game laws of those States. The laws forbidding export usually specify deer or parts of the carcasses of deer; so that the legal shipment of live deer is impossible except in States which make provision for their export for propagating purposes.

Before 1909 the two sections in the game law of New York referring to the killing and sale of deer specified "wild deer," but in the section relating to transportation the word "deer" was unqualified. The manner in which this omission at first affected the owner of a

private preserve is illustrated by the decision rendered in 1907 in the case of *Dieterich v. Fargo*.<sup>a</sup>

The American Express Company refused to receive and transport deer raised and killed in a private preserve in Dutchess County. The owner of the herd, Charles F. Dieterich, found it necessary to kill some of the bucks each year and ship them to New York for sale. On the refusal of the express company to transport his venison, he applied for a temporary injunction against its president, James C. Fargo, claiming that the law prohibiting transportation did not apply to domesticated deer. The supreme court of New York County, in December, 1906, decided in favor of Dieterich. This decision was reversed by the appellate division of the supreme court of the State, May 10, 1907, by a majority of the court. The opinion by Justice O'Gorman was to the effect that the section of the law prohibiting the transportation of deer from one county to another, and requiring express companies to refuse to accept deer when not accompanied by the owner, applied to domesticated as well as to wild deer. The transportation of deer raised on a private preserve was held to be subordinate to the police power of the State. One of the dissenting opinions held that Dieterich had the same natural and legal right to fence his farm and devote it to the propagation of deer that he had to use it for raising cattle or sheep.

To market his deer in 1908 Mr. Dieterich resorted to the novel expedient of paying transportation for a number of men in the city of New York to go to his country preserve, each shoot a deer and accompany the carcass to market, as required by the law. However, the New York court of appeals finally, February 23, 1909, reversed the decision of the lower court and held—one of the six judges dissenting—that the law concerning transportation of venison did not apply to that from domesticated deer bred in confinement, and that the owner of such deer was not restricted as to the number he may kill and ship during the open season. The law regulating transportation of venison has recently been amended to provide for shipment from private preserves.

As would be expected by those familiar with the history of British deer preserves, the laws of the various Canadian Provinces are in general more liberal toward the owners of private deer parks. The general tariff law of Canada permits the export of any home-bred deer under regulations made by the Governor General in Council.

#### KILLING DEER RAISED IN PRIVATE PARKS.

The failure to except deer kept in private preserves from the operation of the laws providing a close season for wild deer prevents the owner of deer from using the venison for food in his own family.

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<sup>a</sup> 102 N. Y., Supp. 720.

He is restricted to a very short open season at a time when, on account of the rut, the animals are least desirable for food. If permitted to sell the venison, even in his own State or county, he must do it during the same limited period, when, owing to the presence of wild game in the market, he may be compelled to accept an extremely low price. To make the business of growing venison profitable, the grower must be able to choose his own time for marketing the product, as in case of beef or pork.

#### SALE OF VENISON.

In more than half the States and Territories the sale of venison from private preserves is illegal at all times, and until recently the sale was illegal in nearly all the States. Several States now forbid the sale of venison produced within them, but permit the sale of that imported from other States, a most unjust discrimination against home industry.

A recent experience in Pottawattamie County, Iowa, illustrates how the law sometimes affects private ownership of deer. The facts are gathered from newspapers, but in the main have been verified by correspondence. J. Cuppy, of Avoca, owned a herd of 20 deer, but died a few years ago without direct heirs and without having made provision for the deer, which had escaped from their inclosure. The administrators could not catch the animals nor lawfully kill them. The herd has increased to nearly 200 head of partly wild deer. They forage on the farms and gardens of the neighborhood, doing some damage, especially to stacks of alfalfa and corn shocks. No one may legally kill them, and prosecutions promptly followed when the county officials learned that a few of them had been shot and converted into venison.

The decision in the case of the State of Missouri *v.* Weber (102 S. W., 955) further illustrates the tendency of courts to give a literal interpretation to laws in order to uphold police regulations concerning game. Eight deer, from which the evidences of sex had been removed, were exposed for sale in the Kansas City market. They had been raised on a stock farm in Henry County, and came from a tame herd which had been in possession of the owner for twenty-five years. They were kept with cattle in a pasture surrounded by a high fence. The animals were never hunted, but the owner had been accustomed to kill several of them every year for sale in the Kansas City market. Defendant Weber was arrested and tried in the Jackson County criminal court in December, 1906. The defense was that the law did not refer to tame but to wild deer. The defendant was found guilty, and appealed his case. It was transferred from the court of appeals to the supreme court, which in its decision upheld the lower court. The court held that the law applied

to tame deer as well as wild, and further that the act did not violate the constitutional prohibition of taking private property for public uses without compensation.

George S. Good, of Lock Haven, Pa., wrote in April, 1908, that deer had multiplied so rapidly in the preserve belonging to the Otzinachson Rod and Gun Club that the annual increase would soon reach about 1,000 animals. He thought the time not far distant when the club would be compelled to market or dispose of 1,000 deer each year to prevent overstocking the preserve. But at that time the law of the State did not permit the club to sell these animals except to stock other preserves; neither could they be killed except in strict conformity with the laws of the State concerning wild deer. Each of the 14 members of the club or guests of the club could take one deer in the open season.

If the surplus animals from large preserves like that just mentioned could be turned into venison and sold judiciously, they would become a source of steady revenue. A thousand adult deer marketed when the time is favorable should yield a gross income of nearly \$25,000 a year. The Pennsylvania legislature of 1909 passed a law providing a means by which venison from private parks may be sold in the open season.

Attorney-General Atkinson, of Washington, in 1906, delivered an opinion concerning game raised in captivity, part of which is of interest in this connection:

It is a well-known principle of law in States generally that wild birds or animals which have been kept in captivity and have become more or less domesticated, when reclaimed by the art and power of man, are the subject of qualified property, and are, as a general rule, under the protection of the law the same as any other property, and are at the disposal of the owner for using or selling as he desires. This seems to have been the law for thousands of years in civilized countries, and it would seem to have been the sensible principle to follow; for without doubt all animals and birds were once wild in *feræ naturæ* state, and by the application of this principle all people have tamed and acquired domesticity in animals and fowls from the game state, from elephants and horses and cattle down to chickens and canary birds.

It is my opinion that our laws in this State covering the subject were intended by the legislatures to relate strictly to game, meaning animals and birds in their wild, free, roving state, and these statutes were not intended in any manner to limit or prevent any probable or possible occupation or industrial development relating to the growing and raising and domesticating of any kinds of birds or animals for food products and the general use of the people.

#### STATE LAWS THAT RECOGNIZE PRIVATE OWNERSHIP OF DEER.

Recognition of the rights of private ownership in deer and other big game is now given in laws of the States named below. It will be observed that most of the provisions were enacted recently.

*Arkansas*.—"Nothing in this act shall be so construed as to prevent any person or persons from having in their possession or buying

or selling or shipping or any railroad from receiving for transportation any deer or fawn when such deer or fawn is raised in captivity for domestic purposes and is accompanied by an affidavit from the raiser to this state of facts." (Acts of 1907, No. 43.)

*Colorado.*—No one may maintain a private fish or game preserve for profit without taking out a license to do so. Owners of licensed private preserves are permitted to sell and ship deer or other quadrupeds, if the carcasses or live animals are accompanied by proper invoice and a permit from the state game and fish commissioner. A fee is charged for the license and for each animal shipped by permit. (Laws of 1899, ch. 98.)

*Florida.*—An act passed in 1909 protects private preserves from trespass. Such preserves are limited to 640 acres, and must be carefully posted. The game in them may not be killed for three years, and thereafter only in compliance with the general hunting laws of the State. (Ch. 5940.)

*Illinois.*—"Provided, that any person who breeds and raises deer for market, where the same has been bred and raised within an inclosure, may kill and sell the same from October 1 to February 1." (Laws of 1909, p. 236.)

*Indiana.*—The section against killing and possession of game has this clause: "Provided, that the provisions of this section shall not apply to any person or persons owning or having under his domain or control any deer, buck, doe, or fawn bred or raised in any deer park." This would permit sale of venison, but probably not its export. (Laws of 1907, ch. 219.)

*Iowa.*—The statutes declare it unlawful for any person other than the owner or person authorized by the owner to kill, maim, trap, or in any way injure or capture any deer, elk, or goat, except when distrained as provided by law. As Iowa has no wild deer except the few that have escaped from a private herd, the sale of venison from private preserves is not prohibited.

*Kentucky.*—The state law especially protects game in parks from poaching and trespass. (Stats., sec. 1250.)

*Maine.*—The game and fish commissioners are authorized by law to grant permits to capture moose, caribou, deer, and birds for park purposes within the State. This does not permit the sale of such game. (Rev. Stat. 1903, ch. 32, sec. 40.)

*Massachusetts.*—The owner may at any time kill or sell his own tame deer kept on his own grounds. (Acts of 1907, ch. 307.)

*Michigan.*—An act passed in 1909 makes it unlawful to capture or destroy deer kept within or that have escaped from any private inclosure. (No. 167.)

*Minnesota.*—Persons who desire to domesticate deer, moose, elk, or caribou may secure a permit to do so from the state board of game

and fish commissioners by paying a fee of 50 cents for each animal in captivity and a like fee for each animal added later by natural increase or otherwise. The animals kept in captivity may be sold or shipped within or without the State by written permission from the commission. (Laws of 1899, ch. 161.)

*Missouri.*—"Nothing in this act shall be construed to prevent the shipment of deer or elk, alive or dead, from private preserves, when such elk or deer are raised in captivity." (Laws of 1909, p. 536.)

*New Hampshire.*—The Blue Mountain Forest Association may kill elk, deer, and moose within the confines of its game preserve until January 15 of each year and transport them outside the State at any time when accompanied by a certificate from the fish and game commission. (Pub. Stat. 1901, ch. 131, sec. 6.)

*New York.*—Deer may be sold during the open season, and moose, elks, caribou, and antelope from private parks may be sold during the same period. Common carriers may transport animals into the State for breeding purposes. The section forbidding transportation of venison was recently (1909) amended to provide that it "shall not apply to domesticated deer propagated in wholly inclosed deer parks, when shipments made from such parks are accompanied by a permit issued by the forest, fish, and game commission under conditions prescribed by the commissioner." (Ch. 474.)

*North Carolina.*—Twenty-two counties permit the owner and keeper of an inclosed game reserve, who raises deer for use or sale, to kill, sell, or use those raised or kept in said inclosure. These laws were passed in 1907 and 1909.

*North Dakota.*—The state game and fish board of control is authorized to issue permits to breed or domesticate any of the game birds or animals mentioned in the law. An annual report is required from persons holding such permits, and they may sell or ship game within or without the State upon receipt of written permission to do so from the board. (Laws of 1909, ch. 128.)

*Oklahoma.*—A section of the law passed in 1909 permits the sale of domesticated game animals and birds within the State. The law is silent on the subject of their export. (Ch. 19.)

*Pennsylvania.*—The state board of game commissioners may issue propagating certificates to individuals or associations that desire to raise deer or other large game animals. The land shall be inclosed by an approved wire fence not less than 8 feet high. All wild deer must first be driven from the land under the direction of a representative of the state board. A careful account of all game raised or brought to the preserve must be kept and reports of any increase made annually to the board. Deer may be killed inside the preserve and shipped only during the open season and for thirty days thereafter. They may be shipped alive for propagating purposes at any

time. Each deer or carcass of deer shipped from the preserve must bear a tag furnished by the state board, by which it may be identified at any time. (Acts of 1909, No. 204.)

*South Dakota.*—The state game warden may issue permits to breed or domesticate deer, moose, elk, caribou, buffalo, or game birds. Annual reports are required from holders of permits. On receipt of written permission from the game warden, any of the animals held in possession in private preserves may be sold or shipped within or without the State. (Laws of 1909, ch. 240.)

*Vermont.*—A person may kill, sell, or dispose of deer which were obtained without the State and are owned and confined by him in a park or inclosure. (Pub. Stat. 1906, sec. 5326.)

*Wisconsin.*—The fish and game warden may issue permits to breed or domesticate deer, moose, elk, or caribou. A system of marking the animals in preserves established under the permits is authorized, and such animals may be sold or shipped within or without the State upon receipt of written permission to do so from the state game and fish warden. A tag identifying the animal by number must accompany every carcass or part of the carcass shipped or exposed for sale. (Laws of 1909, ch. 525.)

A few other States except from the declaration of state ownership of game that which is "under private ownership legally acquired." In the absence of specific laws permitting the sale and export of such game, there is uncertainty as to how courts would decide concerning the rights of game propagators in these States.

### RESOLUTIONS BY THE AMERICAN BREEDERS' ASSOCIATION.

At the annual meeting of the American Breeders' Association held in Washington, D. C., January 28-30, 1908, the subject of breeding game and fur mammals had an important place on the programme, and at the close of the sessions, January 30, the following preamble and resolution were adopted:

Whereas there are vast possibilities in our wild meat, fur, and game mammals, and birds, as a basis for stocking our private and public forest reserves and game preserves with a view to the conservation and fuller utilization of our natural resources and as a source of blood to be used in forming hybrids with domestic animals; therefore,

*Resolved*, That the American Breeders' Association urge the attention of Congress, of state legislatures, sportsmen's societies, and private parties to the preservation of the American bison, the various members of the deer family, mountain sheep, arctic foxes, grouse, pheasants, quail, and other mammals and birds, and the carrying out of experiments to determine their wide use on lands not suited to domestic species and the determination of their value in the foundation of hybrid animals designed for production under wild and semidomesticated conditions.

At the annual meeting of the same association held at Columbia, Mo., January 6-8, 1909, the following resolution was adopted:

*Resolved*, That state laws regulating shooting, possession, and handling of game should be amended so as to permit the sale of live game for propagation at all times. That hand-reared game and game reared in a wild state by breeders (including farmers) should be distinguished by law so that such preserved game can be sold legally under state regulations, except during the breeding season.

### SUMMARY.

The foregoing information relating to the raising of deer, elk, and other large game animals in confinement may be briefly summarized in the following conclusions:

The rearing of wild game mammals, both native and introduced, offers a promising field for experiment, as well as for the practical investment of capital.

The Rocky Mountain elk and the Virginia deer can be reared successfully and cheaply under different conditions in regard to food and climate, as has been proved by many successful experiments. The complete domestication of either species is a possibility which, if realized, would be a source of lasting benefit to the world. With proper encouragement, the production of venison from both elk and deer can be made profitable industries on lands unsuited for cattle, horses, or sheep. The rearing of both species for stocking parks and game preserves would for a time be even more profitable than the production of venison.

Instead of hampering breeders by restrictions, state laws should be modified so as to encourage the raising of deer as a source of wealth to the individual and the State. Safeguards against the destruction and sale of wild deer for domesticated deer are necessary. For this purpose a system of licensing private parks or of inspecting and tagging or otherwise marking live animals or carcasses sold or shipped is recommended.

It is believed that with proper encouragement much of the otherwise waste land in the United States may be made to yield profitable returns from the production of venison, and that this excellent and nutritious meat, instead of being denied to 99 per cent of the population of the country, may become as common and as cheap in our markets as mutton.



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HAIRY AND DOWNY WOODPECKERS.

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U. S. DEPARTMENT OF AGRICULTURE  
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HENRY W. HENSHAW, *Chief*

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FOOD OF THE WOODPECKERS OF THE  
UNITED STATES

BY

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*Assistant, Biological Survey*



WASHINGTON  
GOVERNMENT PRINTING OFFICE  
1911



## LETTER OF TRANSMITTAL.

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U. S. DEPARTMENT OF AGRICULTURE,  
BIOLOGICAL SURVEY,  
*Washington, D. C., December 23, 1910.*

SIR: I have the honor to transmit herewith for publication as Bulletin No. 37 of the Biological Survey, a report on the Food of the Woodpeckers of the United States, by F. E. L. Beal, assistant, Biological Survey. The diminished supply of timber and its greatly increased cost render the conservation of our remaining forests exceedingly important. It has been estimated that within the United States insects destroy trees and lumber to the value of upward of \$100,000,000 annually. As boring insects are the natural enemies of trees, so birds are their natural allies. Of all birds that further the welfare of the forest, woodpeckers are the most important, many of them indeed being specially adapted to dig into wood in order to reach insect larvæ safe from all other enemies. While most woodpeckers are thus highly beneficial, the sapsuckers are injurious, since they subsist to a considerable extent on the cambium or inner bark of trees. This bulletin is meant to serve a practical end by describing the food habits of the several species, and by pointing out the extent to which each is beneficial or injurious, so that the forester, the farmer, and the orchardist may know friend from foe.

Respectfully,

H. W. HENSHAW,  
*Chief, Biological Survey.*

Hon. JAMES WILSON,  
*Secretary of Agriculture.*



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# FOOD OF WOODPECKERS.

(Picidæ.)

## INTRODUCTION.

During the last few decades much interest has been aroused in the preservation and extension of forest areas within the United States, and large sums of money have been spent on our National Forests. Meanwhile scientists have been studying means to combat the insect enemies of forests, which in some cases have threatened the total destruction of large tracts. There is probably no species of land plant that has not at least one insect enemy, and the trees of the forest furnish food and homes for legions. In the Fifth Report of the United States Entomological Commission over 400 species of insects are reported to feed on the oak, and the opinion is expressed that this number is far below the total. In the same work about 80 species are said to feed on the elm, 170 on the hickory, 41 on the locust, 100 on the maple, 105 on the birch, 186 on the willow, and 165 on the pine; and in each case the list is confessedly incomplete.

On this point Dr. Hopkins has said:

The results of investigation lead to the conclusion that the annual loss from insect work on forest trees, and their crude or finished products, amounts to at least \$100,000,000.

No period in the life history of a tree is exempt from insect attack, and every part, from the smallest roots to the terminal buds, leaves, flowers, and fruit, may be infested by one or many species. The seed in the ground, the tender shoots of both roots and stems, and the young seedling to the matured tree, may be attacked by special enemies which injure or destroy different parts of the entire plant. In fact, living, diseased, dead, or decaying, a tree may be the home of hundreds of species and thousands of individuals of insect life.<sup>1</sup>

Wherever the *Dendroctonus* beetles have been found in standing timber, the work of woodpeckers has been more or less common, and in some trees quite a large percentage of the beetle broods has been destroyed by the birds. The evidence gathered in Maine a few years ago indicates quite conclusively that the birds were rendering a most valuable service as a natural check to the multiplication and destructive work of the eastern spruce beetle. The work of birds is common in sections where species 1 [*Dendroctonus brevicornis*], 9 [*D. monticola*], and 10 [*D. ponderosæ*], and other western species are prevalent. Yet birds evidently render the greatest service where but few trees are being killed, since their concentrated work may prevent an abnormal increase of the beetles; but where many hundreds or thousands of trees are being killed, the limited number of birds can have little or no effect. Therefore, while the birds are among the foresters' valuable friends, they can not, even with the utmost protection, always be relied upon to protect the forest from its enemies.<sup>2</sup>

<sup>1</sup> From manuscript of lecture on Forest Insects and Their Destructive Work, by Dr. A. D. Hopkins, in charge of Forest Insect Investigations, Bureau of Entomology, U. S. Dept. Agric.

<sup>2</sup> Hopkins, A. D., Bull. 83, Bureau of Entomology, U. S. Dept. Agric., Part I, pp. 27-28, 1909.

From these considerations it is at once apparent how important must be any agency that restrains or limits this great army of tree destroyers. Of all birds that further the welfare of trees, whether of forest or orchard, woodpeckers are the most important. The value of their work in dollars and cents is impossible to calculate, but careful study of their food in both field and laboratory has brought out many facts of practical importance.

Woodpeckers are essentially arboreal in their habits and obtain the greater part of their food from trees. Their physical conformation eminently adapts them to this mode of life. Their legs are rather short and stout, and the toes are furnished with strong, sharp claws. With the exception of the genus *Picoides*, all North American woodpeckers have four toes, two of which point forward and two backward. To further aid in maintaining themselves on the trunks of trees, their tails are composed of stiff feathers terminating in sharp spines, which can be pressed against the

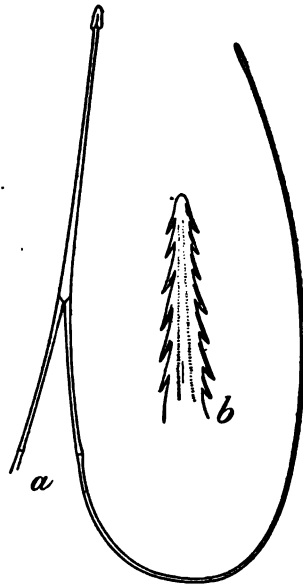


FIG. 1.—Tongues of woodpeckers.

bark and so serve as a prop to hold the bird in an upright position while it is at work. Woodpeckers are thus enabled to cling easily to the trunks and branches and to strike effective blows with their beaks upon the bark or wood.

As much of the food of woodpeckers is obtained from solid wood, Nature has provided most of them with a stout beak having a chisel-shaped point, which forms an exceedingly effective wood-cutting instrument. But the most peculiar and interesting point in the anat-

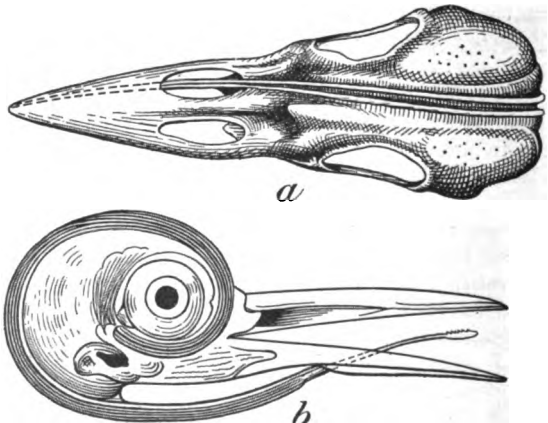


FIG. 2.—Special development of tongues of woodpeckers.

omy of these birds is the tongue. This is more or less cylindrical in form and usually very long (fig. 1, a). At the anterior end it generally terminates in a hard point, with more or less barbs upon the sides (fig. 1, b). Posteriorly the typical woodpecker tongue is

extended in two long, slender filaments of the hyoid bone which curl up around the back of the skull and, while they commonly stop between the eyes, in some species they pass around the eye (fig. 2, *b*), but in others enter the right nasal opening and extend to the end of the beak (fig. 2, *a*). In this last case the tongue is practically twice the length of the head. Posteriorly this organ is inclosed in a muscular sheath by means of which it can be extruded from the mouth to a considerable length, and used as a most effective instrument for dislodging grubs or ants from their burrows in wood or bark. Hence, while most birds have to be content with such insects as they find on the surface or in open crevices, the woodpeckers devote their energies to those larvæ or grubs which are beneath the bark or even in the heart of the tree. They locate their hidden prey with great accuracy and often cut small holes directly to the burrows of the grubs. In



FIG. 3.—Wood from which woodpecker has extracted insect.

figure 3 the grub had eaten a burrow through the heart of a maple sapling, but its position was accurately determined by the bird, which then cut through the solid live wood until it reached the burrow and extracted the insect.

In the United States, exclusive of outlying possessions, there are about 45 species and subspecies of this family, most of which are of decided economic importance. As a family they are much less migratory than most other birds, and a majority of the species occupy the same range throughout the year, which adds materially to their value to farmers. Their food consists so largely of wood-boring grubs, hibernating insects, and insects' eggs and pupæ that their supplies do not fail even in the coldest weather.

The present paper is based upon the examination of 3,453 stomachs of woodpeckers representing 16 species and nearly twice as many subspecies, taken in all parts of the United States, with a few from Canada. In the following table the species are arranged in the

order of the average amount of animal food contained in their stomachs.

Name of species.	Number of stomachs.	Per cent of animal food.	Per cent of vegetable food.
Three-toed woodpecker ( <i>Picoides americanus</i> ).....	23	94.06	5.94
Arctic three-toed woodpecker ( <i>Picoides arcticus</i> ).....	28	88.69	11.31
Williamson sapsucker ( <i>Sphyrapicus thyroideus</i> ).....	17	86.67	13.33
Red-cockaded woodpecker ( <i>Dryobates borealis</i> ).....	76	81.06	18.94
Nuttall woodpecker ( <i>Dryobates nuttalli</i> ).....	53	79.41	20.59
Hairy woodpecker ( <i>Dryobates villosus</i> ).....	382	77.67	22.33
Downy woodpecker ( <i>Dryobates pubescens</i> ).....	723	76.05	23.95
Pileated woodpecker ( <i>Phloxotomus pileatus</i> ).....	80	72.88	27.12
Red-breasted sapsucker ( <i>Sphyrapicus ruber</i> ).....	34	68.92	31.08
Red-shafted flicker ( <i>Colaptes cafer</i> ).....	183	67.74	32.26
Flicker ( <i>Colaptes auratus</i> ).....	684	60.92	39.08
Yellow-bellied sapsucker ( <i>Sphyrapicus varius</i> ).....	313	49.31	50.69
Lewis woodpecker ( <i>Asyndesmus lewisii</i> ).....	59	37.48	62.52
Red-headed woodpecker ( <i>Melanerpes erythrocephalus</i> ).....	443	33.83	66.17
Red-bellied woodpecker ( <i>Centurus carolinus</i> ).....	271	30.94	69.06
California woodpecker ( <i>Melanerpes f. bairdi</i> ).....	84	22.59	77.41
Total.....	3,453		
Average.....		64.26	35.74

It is not probable that these relations are absolute in every case. The position of *Sphyrapicus ruber* above the two species of *Colaptes* is perhaps accidental, and the examination of a few stomachs more or less would be likely to change slightly the relative positions. The vegetable food, of course, stands in an inverse ratio to the animal. Mineral matter (sand) is not taken largely by woodpeckers. The most is found in the stomachs of the flickers, but it is probably picked up accidentally with ants, of which these birds eat great numbers. Ants constitute the largest item of animal food—28.41 per cent, considering the whole 16 species collectively—and are actually the largest item in the stomachs of 8 species. The Williamson sapsucker, the red-cockaded woodpecker, and the two flickers take the highest rank in this respect. Beetles stand next in importance, and amount to 20.42 per cent. These two items together form nearly half the food. The remainder of the animal food is composed of insects, with a few spiders, millepeds, and sowbugs, and occasionally a salamander, tree frog, lizard, or snail. In the following table is given the average percentage of ants and beetles in the stomach. The species are arranged in the order of their rank as ant eaters.

Name of species.	Per cent of ants.	Per cent of beetles.
Williamson sapsucker ( <i>Sphyrapicus thyroideus</i> ).....	85.94	0.13
Red-cockaded woodpecker ( <i>Dryobates borealis</i> ).....	56.75	11.02
Red-shafted flicker ( <i>Colaptes cafer</i> ).....	53.82	6.55
Flicker ( <i>Colaptes auratus</i> ).....	49.75	5.14
Red-breasted sapsucker ( <i>Sphyrapicus ruber</i> ).....	42.49	4.02
Pileated woodpecker ( <i>Phloxotomus pileatus</i> ).....	39.91	22.01
Yellow-bellied sapsucker ( <i>Sphyrapicus varius</i> ).....	34.31	6.02
Downy woodpecker ( <i>Dryobates pubescens</i> ).....	21.36	21.55
Hairy woodpecker ( <i>Dryobates villosus</i> ).....	17.10	41.42
Lewis woodpecker ( <i>Asyndesmus lewisii</i> ).....	11.87	9.12
Three-toed woodpecker ( <i>Picoides americanus</i> ).....	8.29	71.05
Nuttall woodpecker ( <i>Dryobates nuttalli</i> ).....	8.19	28.86
California woodpecker ( <i>Melanerpes f. bairdi</i> ).....	8.09	2.67
Red-bellied woodpecker ( <i>Centurus carolinus</i> ).....	6.45	10.18
Arctic three-toed woodpecker ( <i>Picoides arcticus</i> ).....	6.35	67.66
Red-headed woodpecker ( <i>Melanerpes erythrocephalus</i> ).....	5.17	18.85
Average.....	28.49	20.39

If the 16 species of woodpeckers herein discussed were arranged in the order of their usefulness according to their food, they would stand about as at top of page 10, except that the 3 species of *Sphyrapicus*, owing to their sap-sucking propensities, might be placed at the foot of the column. It is unfortunate that so few stomachs of the three or four species nearest the top have been received, but probably those examined were in no way exceptional. The 2 species of *Picoides* are among the most useful birds, especially in the forest, of which they are preeminently the conservators. More than 60 per cent of the animal food of these two birds consists of the larvæ of wood-boring beetles, which they dig from the bark and wood of trees. The two species *Dryobates pubescens* and *D. villosus* do not fall far behind in this good work, and several others eat very appreciable quantities of wood borers. Among the beetles eaten by the different birds are naturally some useful species, such as the predaceous ground beetles (Carabidæ) or tiger beetles (Cicindelidæ). The redhead eats useful beetles to the extent of 7.34 per cent of its diet, the Lewis woodpecker, with 6.7 per cent, stands next on the list of offenders in this respect, followed by the red-shafted flicker with 3.9 per cent, and the eastern flicker with less than 2 per cent. No other species had eaten so much as 1 per cent of these beetles. Whatever sins woodpeckers may commit, the destruction of useful beetles is not one of them.

Nearly all the vegetable food, except a few seeds, including some grain, can be included under three items—fruit, cambium, and mast. The greatest interest attaches to the cambium, which is a jellylike substance found just under the bark of growing trees and from which both wood and bark are formed. The smaller species of woodpeckers have been accused of pecking the bark from fruit and forest trees to an injurious extent in order to get this substance. While nearly all members of the family eat some cambium, the only ones that really do much harm by the habit appear to be the yellow-bellied sapsucker (*Sphyrapicus varius*) and others of the same genus. With the yellow-bellied sapsucker cambium amounts to about 17 per cent of the annual food and in April reaches 48 per cent. As the substance is often semifluid, probably much passes almost immediately out of the stomach, leaving only the harder and less easily digested part, so that a much larger amount is eaten than is shown by stomach examination.

In obtaining the cambium the bird sometimes denudes the tree of its bark over a considerable area, and so ruins it for any economic use except fuel; at other times a series of single punctures are made in lines extending around the tree, and as new layers of wood grow over these, the indentation at each puncture becomes less and less pronounced. If, after some years, this timber be cut and sawed,

a tangential or circular cut across the punctures gives a bird's-eye appearance very similar to that which Nature produces in some maples. A radial cut through the punctures gives the curly look often found in many woods. It frequently happens, however, that water enters at the punctures and causes a slight decay, which usually disfigures the wood by making a dark stain, though occasionally the effect is ornamental.

With the possible exception of the crow, no birds have been subject to so much adverse criticism as the woodpeckers. When they are seen scrambling over fruit trees and fresh holes are found in the bark, it is concluded that they must be doing harm. But woodpeckers, except a few species, rarely disfigure a healthy tree, but when they find a tree infested by wood-boring larvæ, they locate the insects accurately, draw them out, and devour them. If in succeeding years the burrows formerly occupied by the larvæ are used by a colony of ants, they in turn are dug out and destroyed.

The following are samples of testimony by Dr. Hopkins and other eminent entomologists to the persistent and effective work of woodpeckers in destroying wood-boring beetles and other insect enemies of trees:

As has already been stated, woodpeckers are the most important enemies of the bark beetle, and appear to be of inestimable value to the spruce-timber interests of the Northeast. Indeed, I feel confident that in the many hundreds of infested trees examined at least one-half of the beetles and their young had been destroyed by the birds, and in many cases it was evident that even a greater proportion had perished from this cause alone.

Estimating 100 beetles to the square foot of bark in the average infested tree, and an average of 60 square feet of infested bark, it is possible for each tree to yield an average of 6,000 individuals; 100 trees, 600,000, and so on. It is therefore plain that, if one-half or two-thirds of this number are destroyed by the birds and other enemies, the amount of timber the remainder can kill will be lessened. This is all the more apparent when it is remembered that it is only when the beetles occur in great numbers that they can overcome the resistance of the living trees.<sup>1</sup>

Birds contribute their share, also, in destroying larvæ and pupæ. The work of woodpeckers was found upon most of the trees which had been killed by *Dendroctonus brevicomis*, and these birds had evidently destroyed a large percentage of the insects in some of the trees.<sup>2</sup>

As natural enemies of this insect [the maple borer, *Plagionotus speciosus*] it is probable that various species of woodpeckers render the greatest service. At Huntington, Mass., I have seen the hairy woodpecker, the downy woodpecker, and the flicker feeding upon white larvæ taken from beneath the bark of maples infested by this borer.<sup>3</sup>

Woodpeckers do much good by hammering holes in the bark of infested cottonwoods and devouring the young carpenter worms [larvæ of *Cossus populi*]. We certainly ought to protect these feathered friends of ours instead of allowing every small boy in the country to shoot them whenever he pleases.<sup>4</sup>

<sup>1</sup> Hopkins, A. D., Bull. 28 (new ser.), Division of Entomology, U. S. Dept. Agric., pp. 23, 25-26, 1901.

<sup>2</sup> Webb, J. L., Bull. 58, Part II, Bureau of Entomology, U. S. Dept. Agric., p. 27, 1906.

<sup>3</sup> Kirkland, A. H., in Mass. Crop Report for June, 1897, p. 32, 1897.

<sup>4</sup> Doten, S. B., Bull. 49, Nevada Agric. Exper. Sta., p. 12, 1900.

I have found no parasite of this larva [*Hepialus argenteomaculatus*], but I have seen that the woodpeckers are its deadly foes. In April, 1886, I had a favorable opportunity to search for the borer and was astonished at the scores removed by these birds. They often drill through a deep layer of wood; often two holes are made one above the other, the purpose being obvious. The morsel is evidently located, or its burrow rather, by sounding, as I noticed many instances in which a row of punctures surrounded the base of the alder. The destroyers are sometimes mistaken, for I found their drillings, evidently made in search of this larva, in sound wood in which there were no borers, but these were few compared with the successful trials.

Is it the activity of these birds, that prevents the abundance in the forests of certain borers, e. g. *Aegeria acerni*, whilst the same insect is often destructively abundant in the ornamental maples of cities and villages? <sup>1</sup>

### HAIRY WOODPECKER.

(*Dryobates villosus* subsp.)

The hairy woodpecker (frontispiece), in one or another of its various forms, inhabits the whole of temperate North America, but is rare over some extensive areas. It is a rather restless, noisy bird, as compared with its smaller relative, the downy, and makes itself conspicuous by loud calls and rapid flights from tree to tree. It is eminently arboreal in its habits and gets most of its food from trees. While sometimes found in the midst of a dense forest, it prefers the outer edge of the woodland or groves or orchards. In the latter it is quite at home, especially if the trees be old and neglected, for then they usually offer decayed knots and limbs where wood borers establish their colonies. The bird is not migratory, unless within very narrow limits, and where it occurs at all can usually be found the year round. It nests in a cavity which it excavates in a partly decayed trunk or branch. While often seen in the orchard, the hairy does not go there for fruit. More than three-fourths of its food consists of animal matter, and less than a fourth of the remainder is fruit, mostly of wild species.

In the investigation of the food of the hairy woodpecker detailed below, 382 stomachs were examined. They were obtained from 33 States and Territories, the District of Columbia, and Canada, and were taken in every month of the year. They undoubtedly embrace all the recognized subspecies, but as some of them were collected before all the forms had been defined, they can not now be distinguished. However, as the food of the various subspecies does not differ materially, the species has been treated as a whole. In the first analysis the food divides into 77.67 per cent of animal matter and 22.33 of vegetable. The animal food consists of insects, with a few spiders and millepeds; the vegetable part is made up of fruit, seeds, and a number of miscellaneous substances. This ratio of animal to vegetable does not vary greatly during the year, the greatest difference

<sup>1</sup> Kallcott, D. S., *Insect Life*, I, 251, Feb., 1889.

occurring in June, when the stomachs show 90 per cent of animal to 10 per cent of vegetable food. There is, however, no regular increase or decrease as the seasons change, such as is noted in birds that subsist upon flying insects and summer fruits. The wood-boring larvæ upon which this bird so largely feeds can be obtained at all times of the year, and the same is true of most of the vegetable food.

*Animal food.*—The largest item in the annual diet of the hairy woodpecker consists of the larvæ of cerambycid and buprestid beetles, with a few lucanids and perhaps some other wood borers. These insects constitute over 31 per cent of the food and are eaten in every month of the year. The greatest amount is taken in December, when it reaches 41 per cent of the whole; and in May, the month of least consumption, it still amounts to over 21 per cent. This shows how earnest these birds are in their efforts to procure this kind of food. In summer, insects and small fruits abound—enough to satisfy appetite and in variety apparently suited to every taste—but the birds still search for and obtain these wood-boring grubs to the extent of a fifth or more of their daily food, at the cost of hours of hard labor in digging them from the tree. One stomach contained 100 of these larvæ and 83 and 50, respectively, were taken from two others. Of the 382 stomachs, 204, or 53 per cent, contained these grubs, and 27 of them held no other food. Other beetles amount to a little more than 9 per cent. They are distributed among a number of families, but are nearly all more or less harmful.

Weevils (Rhynchophora), or snout beetles, aggregate a little more than 3 per cent, and are mostly represented by the curculios (Curculionidæ) and engraver beetles (Scolytidæ). One of the former, *Dorytomus mucidus*, seems to be a favorite, as it was found in a number of stomachs, of which one contained 109 and another 63 individuals. The engravers were found in 18 stomachs. One contained 50 adults and 25 larvæ; another, 21 adults and 10 larvæ. They were of such species as *Tomicus cælatus* and *Polygraphus rufipennis*. Of the latter, 17 individuals were taken from one stomach. A few carabids, or predaceous ground beetles, were also found. The average amount of these useful insects consumed is sixty one-hundredths of 1 per cent (0.60). The month of greatest consumption is March, when they are eaten to the extent of 2.46 per cent of the whole food. Evidently this bird does little harm by eating useful beetles.

Ants stand second in importance in the diet of the hairy woodpecker. They amount to a little more than 17 per cent, and are eaten in every month. In January, which is the month of greatest consumption, they reach more than 27 per cent and nearly the same in February. They are apparently eaten the least in November, when they aggregate somewhat more than 10 per cent, but this may be accidental, as both October and December show higher percentages and July practically the same. In a general way these insects

are eaten most in winter and early spring, but every month has a good percentage. Hymenoptera other than ants are taken very irregularly and in small quantities. In September somewhat more than 5 per cent were eaten, but stomachs taken in May and December contained none at all, and the average for the year is but a little more than 1 per cent. In one stomach were found sawfly larvæ, insects which do not appear to be eaten extensively by birds.

Caterpillars are the next most important item of the hairy's food. They amount to a little less than 10 per cent, and were found in every month. The greater number were taken in August, when they aggregated nearly 19 per cent, while March showed the least, a little less than 2 per cent. Many of them were wood-boring species dug out from the wood, like the beetle larvæ. Prof. F. M. Webster states that he has seen a hairy woodpecker successfully peck a hole through the parchment-like covering of the cocoon of a *Cecropia* moth and devour the contents. On examining more than 20 cocoons in a grove of box elders, he found only 2 uninjured.

Bugs (Hemiptera) are evidently not a favorite food, as they were found only to the extent of 2.41 per cent for the year. June appears to be the month of greatest consumption, with somewhat less than 8 per cent, but four months show none at all, and bugs are very irregularly distributed through the rest of the year. Plant-lice (aphids) were found in 2 stomachs and scales in 4. One of the latter was identified as the cherry or plum scale (*Eulecanium cerasifex*). Orthoptera, that is, grasshoppers, crickets, and cockroaches, are rarely eaten by the hairy. A few eggs, probably those of tree crickets, and the egg cases (oötheca) of cockroaches, constitute the bulk of this food. These with a few miscellaneous insects amount to a little more than 2 per cent for the year. Spiders with their cocoons of eggs, including one jointed spider (Solpugidæ), and a few millepedes, were eaten to the extent of about 3.5 per cent, which completes the quota of animal food.

The following is a list of insects identified in the food of the hairy woodpecker:

## COLEOPTERA.

*Agonoderus pallipes*.  
*Ips fasciatus*.  
*Melanotus cribricollis*.  
*Chrysobothris* sp.  
*Cymatodera undulata*.  
*Lachnosterna* sp.  
*Ergates* sp.  
*Asemum mæstum*.  
*Eleodes* sp.

*Nyctobates pennsylvanica*.  
*Upis ceramboides*.  
*Boletotherus bifurcus*.  
*Boletothphagus corticola*.  
*Dendroides* sp.  
*Dorytomus mucidus*.  
*Tomicus cætatus*.  
*Polygraphus rufipennis*.

## HYMENOPTERA.

Ant (*Camponotus pictus*).

## DIPTERA.

Bluebottle fly (*Phormia* sp.).

## HEMIPTERA.

Plum and cherry scale (*Eulecanium cerasifer*). Harvest fly (*Tibicen rimosa*).

*Vegetable food.*—The vegetable food of the hairy woodpecker may be considered under four heads: Fruit, grain, seeds, and miscellaneous vegetable substances. Fruit amounts to 5.22 per cent of the food, and was contained in 54 stomachs, of which 13 held what was diagnosed as domestic varieties, and 41 contained wild species. Rubus seeds (blackberries or raspberries) were identified in 4 stomachs, and were counted as domestic fruit, but it is perhaps more probable that they were wild. Strawberry seeds (occurring in 1 stomach) and pulp (thought to be apple) were the only other cultivated varieties that could be distinguished with a reasonable degree of certainty. Evidently the hairy woodpecker does no damage by preying upon orchard or garden products. Of wild fruit 18 species were identified. It constitutes the great bulk of the fruit eaten, and is nearly all of varieties not useful to man.

Corn was the only grain discovered in the food. It was found in 10 stomachs, and amounted to 1.37 per cent. In 2 stomachs taken in August and September it was still in the milk, but all the rest was eaten in winter, so it must have been waste. Seeds of various plants had been eaten by 18 birds, but most of them were of little economic value. The seed of poison ivy and poison sumac (*Rhus radicans* and *R. vernix*) were found in 17 stomachs, and as they usually pass through the alimentary canal uninjured, the birds do some harm by scattering the seeds of these noxious plants. The total percentage of seeds of all kinds is 4.50.

Cambium, or the inner bark of trees, was identified in 23 stomachs. Evidently the hairy does but little damage by denuding trees of their bark. Mast, made up of acorns, hazelnuts, and beechnuts, was found in 50 stomachs. It was mostly taken in the fall and winter months, and appears to be quite a favorite food during the cooler part of the year. Dr. Merriam says that in northern New York the hairy woodpecker, like the other woodpeckers of the Adirondack region, feeds largely on beechnuts. In late fall, winter, and early spring following good yields of beechnuts, the nuts form the principal food of the woodpeckers. When grubs and ants are taken from decayed or decaying trees, bits of rotten wood, dead leaves, and other rubbish are eaten with them. Such material was found in 72 stomachs, though in most cases the percentage was small. Cambium, mast, and rubbish together constitute a little less than 11 per cent of the food.

The following is the list of fruits and seeds identified in the food:

Foxtail grass ( <i>Ixophorus</i> sp.).	Juneberry ( <i>Amelanchier canadensis</i> ).
Bayberry seed ( <i>Myrica carolinensis</i> ).	Northwestern Juneberry ( <i>Amelanchier alnifolia</i> ).
Hazelnut ( <i>Corylus</i> sp.).	Chokeberry ( <i>Aronia</i> sp.).
Beechnut ( <i>Fagus americanus</i> ).	Strawberry ( <i>Fragaria</i> sp.).
Acorn ( <i>Quercus</i> sp.).	Chokecherry ( <i>Prunus virginiana</i> ).
Mulberry ( <i>Morus rubra</i> ).	Black or rum cherry ( <i>Prunus serotina</i> ).
Sassafras berry ( <i>Sassafras sassafras</i> ).	Woodbine berry ( <i>Parthenocissus quinquefolia</i> ).
Spice berry ( <i>Benzoin benzoin</i> ).	Frost grape ( <i>Vitis cordifolia</i> ).
Pigweed ( <i>Amaranthus</i> sp.).	Sumac ( <i>Rhus glabra</i> ).
Pokeberry ( <i>Phytolacca decandra</i> ).	Poison sumac ( <i>Rhus vernix</i> ).
Vervain ( <i>Verbena</i> sp.).	Poison ivy ( <i>Rhus radicans</i> ).
Blueberry ( <i>Vaccinium</i> sp.).	Black mustard ( <i>Brassica nigra</i> ).
Elderberry ( <i>Sambucus canadensis</i> ).	Barberry ( <i>Berberis</i> sp.).
Sour gum ( <i>Nyssa sylvatica</i> ).	Magnolia ( <i>Magnolia fatida</i> ).
Flowering dogwood ( <i>Cornus florida</i> ).	
Rough-leaved dogwood ( <i>Cornus asperifolia</i> ).	

*Summary.*—The foregoing analysis of the food of the hairy woodpecker shows that it is a bird from which the orchardist and forester have nothing to fear and much to gain. The quantity of useful insects or economic produce which it eats is insignificant. On the other hand, the number of destructive larvæ which it devours must have a very sensible effect in reducing the abundance of these pests.

#### DOWNY WOODPECKER.

(*Dryobates pubescens* subsp.)

The downy woodpecker (frontispiece) is the smallest member of the family in the United States. With its various forms it occupies practically the whole country and extends north into British America and as far as Alaska. To the ordinary observer it is but a miniature edition of the hairy, as the plumage is practically the same. It is also a quieter bird and probably the least wary and suspicious member of the family. When busy in search of food, it pays little attention to human intruders, and often the first intimation of its presence is a gentle tapping on a dead branch or knot only a few yards away, where a colony of ants or some wood-boring larvæ have established their selves.

Like the hairy, it does not migrate, and may be found on its range at any time during the year. Owing, perhaps, to the absence of so many other birds and the leafless condition of the trees, it seems to be most conspicuous in winter. After the summer visitors have gone southward, the downy has a habit of associating with a mixed company of titmice, creepers, nuthatches, and sometimes a few kinglets, who seem to be bound together by a community of interest in the

matter of food, for they all forage over the bark of the trunks and branches of trees and eat practically the same things.

The following are samples of testimony as to the good work of the downy:

The downy woodpecker, which is so common in Montana and which is so often seen in our orchards, is the fruit-grower's friend. Besides picking up miscellaneous pests it locates burrows of this borer [flat-headed apple-tree borer, *Chrysobothris femorata*] and extracts them in considerable numbers. In the older orchards of Montana scarcely a tree can be found that does not bear the marks of woodpeckers, a large proportion of which are made by this species.<sup>1</sup>

Mr. E. Dwight Sanderson, in speaking of the work of the downy woodpecker, says:

He is the arch enemy of the codling moth and were it not for his good offices in destroying the larvæ in the winter your apple crop might frequently be a failure.<sup>2</sup>

Prof. Samuel Aughey examined four stomachs of the downy woodpecker in Nebraska, all of which contained grasshoppers.

The late Dr. Townend Glover, entomologist of the Department of Agriculture, states that the stomach of a downy woodpecker shot in February "was filled with black ants." He states further:

On one occasion a downy woodpecker was observed by myself making a number of small, rough-edged perforations in the bark of a young ash tree, and upon examining the tree when the bird had flown it was found that wherever the bark had been injured the young larvæ of a wood-eating beetle had been snugly coiled underneath, and had been destroyed by the bird.<sup>3</sup>

In the laboratory investigation of the food of the downy woodpecker 723 stomachs were examined. They were collected in 33 States, the District of Columbia, and Canada. They are quite regularly distributed over the 12 months of the year, and probably represent fairly the average annual food. This is made up of 76.05 per cent of animal matter to 23.95 per cent of vegetable.

*Animal food.*—Beetles taken collectively amount to 21.55 per cent, and are the largest item of the food. Of these, a little less than 14 per cent are wood-boring larvæ, principally cerambycids, with some buprestids. They were found in 289 stomachs, or about 40 per cent of all, and 10 contained no other food. This is only about half the amount found in the stomachs of the hairy woodpecker, and shows that the downy pecks wood much less than the hairy. These larvæ are eaten at all times of the year, though the most are taken in the cooler months. In November they constitute 20 per cent of the food, which is the maximum, though in the other fall months and in the winter and spring months they do not fall far below. In June the minimum of 4.5 per cent was eaten. The economic value of the destruction of these larvæ is very great.

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<sup>1</sup> Cooley, R. A., Bull. 51, Montana Agric. Exper. Sta., p. 226, 1903.

<sup>2</sup> Bull. 131, New Hampshire Agric. Exper. Sta., p. 18, 1907.

<sup>3</sup> U. S. Commissioner of Agric., Rept. for 1865, pp. 37-38, 1866.

Weevils amount to a little more than 3 per cent, but appear to be a rather favorite food, as they were found in 107 stomachs, and 4 contained 50, 36, 34, and 33 adult individuals, respectively, while in another were 100 in the pupal stage. The engravers (*Scolytidæ*) were identified in 12 stomachs. Other beetles aggregate a little less than 5 per cent of the food, and are all more or less harmful except a few carabids, which amount to 0.80 per cent for the year.

Ants are eaten by the downy to the extent of 21.36 per cent of its diet, and are taken more regularly than any other element of the food. October, with 9.85 per cent, appears to be the month of minimum consumption, but it is doubtful if this would always hold, as every other month shows at least twice this amount. Hymenoptera other than ants are eaten very sparingly by the downy. They aggregate only 1.18 per cent, and in June, the month of greatest consumption, amount to only 2.45 per cent, while none were found in the 28 stomachs taken in May.

Hemiptera, or bugs, were found in 111 stomachs, and constitute 8.57 per cent of the food. Scales, or bark lice, were found in 41 stomachs and aphids, or plant lice, in 20. A collection of 10 stomachs taken in Maine in March contained from 90 to 100 per cent of scales, the average for 10 stomachs being 93.10 per cent. This would seem to indicate that where these insects abound, the birds collect and feed upon them almost exclusively. Scales and plant lice together amount to 2.85 per cent of the yearly food. Four genera and two species of scales were identified. Bugs of various other species reach a little less than 6 per cent.

Caterpillars appear to be a very acceptable food for the downy woodpecker, as they constitute 16.50 per cent of the yearly diet. A large proportion of them are of the wood-boring species, and were evidently dug out of the wood, the same as the beetle larvæ. Others are surface feeders taken from leaves and bark. In this connection the greatest interest attaches to the pupæ and larvæ of the codling moth, generally recognized as the worst pest of the apple orchard. These insects, in one stage or the other, were identified in 8 stomachs. While this is a small number, the wonder is that the bird gets them at all. The eggs are minute, and as soon as they hatch the larvæ bore into the fruit, where they feed in security, though it is claimed by some observers that woodpeckers sometimes dig them out. When full grown, they leave the apple and crawl into some cranny, where they change to pupæ. It is in this condition, i. e., as larvæ full grown or pupæ, that they are secured by the birds. One stomach of the downy contained 18, and another 16 of these grubs. As the adult moth flies by night and lies hidden during the day, it is probably not often taken by birds. In any case, it would be hard to identify in the stomachs. Various insects, including grasshoppers and flies,

make up about 2 per cent of the food. Grasshoppers, though so acceptable to many birds, were found in only 2 stomachs of the downy. On the other hand, eggs of grasshoppers, crickets, katydids, and cockroaches were identified in 48 stomachs, mostly taken in the fall and winter. Eleven stomachs from Kansas collected in December deserve special notice. Eight of them contained the eggs of grasshoppers to an average extent of 10 per cent of all the contents. Seven stomachs taken in Illinois in March contained grasshoppers' eggs to an average of over 46 per cent of the whole food. This is evidence of valuable service and emphasizes the fact that this bird resorts to the ground for food in case of necessity.

Miscellaneous insects amount to but 2.80 per cent, but among them is one that deserves particular notice. This is the immature form of the dobson (*Corydalus cornutus*), a large aquatic insect of nocturnal habits, seldom seen except when it approaches a bright light. The larvæ are commonly known as hellgramites, and are usually found under stones in the beds of streams, though sometimes seen among wet rubbish near water. How a woodpecker could obtain these creatures is a mystery, but 1 stomach of the downy contained the remains of at least 4 of the larvæ, and in another was 1 in the pupal stage.

Spiders, millepeds, pseudoscorpions, sowbugs, and a few snails aggregate 4.09 per cent, and complete the quota of the animal food.

The following is a list of insects identified in the food:

#### COLEOPTERA.

<i>Amara</i> sp.	<i>Platydemus</i> sp.
<i>Gynandropus hylacis</i> .	<i>Helops areus</i> .
<i>Stenolophus</i> sp.	<i>Notorus alamedæ</i> .
<i>Ips fasciatus</i> .	<i>Pandeletejus hilaris</i> .
<i>Tenebrioides bimaculata</i> .	<i>Dorytomus mucidus</i> .
<i>Dolopius lateralis</i> .	<i>Dorytomus brevicollis</i> .
<i>Melanotus</i> sp.	<i>Desmoris constrictus</i> .
<i>Chrysobothris</i> sp.	<i>Gymnetron teter</i> .
<i>Calorama</i> sp.	<i>Conotrachelus naso</i> .
<i>Aphodius inquinatus</i> .	<i>Cryptorhynchus ferratus</i> .
<i>Elaphidion</i> sp.	<i>Centrinus</i> sp.
<i>Rhagium lineatum</i> .	<i>Balaninus</i> sp.
<i>Oberea</i> sp.	<i>Xyloterus bivittatus</i> .
<i>Diachus auratus</i> .	<i>Hylesinus aculeatus</i> .
<i>Gastroidea cyanea</i> .	<i>Piezocorynus mixtus</i> .
<i>Melasoma californica</i> .	

#### HYMENOPTERA.

Ants (*Camponotus marginatus* and *C. pennsylvanicus*).

#### LEPIDOPTERA.

Tent caterpillar ( <i>Malacosoma</i> sp.).	Codling moth ( <i>Carpocapsa pomonella</i> ).
Cotton bollworm ( <i>Heliothis obsoletus</i> ).	

## HEMIPTERA.

False chinch bug (*Piesma cinerea*).  
 Red bug (*Largus succinctus*).  
 White scale (*Aspidiotus* sp.).

Oak scale (*Kermes* sp.).  
 Olive scale (*Saissetia oleæ*).  
 Plum and cherry scale (*Eulecanium cerasifer*).

## ORTHOPTERA.

Large meadow grasshopper (*Orchelimum glaberrimum*).

## NEUROPTERA.

Dobson (*Corydalis cornuta*).

*Vegetable food*.—Fruit was eaten to the extent of 5.85 per cent of the whole food. Most of it is of useless wild varieties. Ten species were identified by their seeds, of which the *Rubus* fruits, i. e., raspberries or blackberries, might have been cultivated, but probably were not. They were found in only 1 stomach. A number of stomachs contained fruit pulp, which could not be further identified and may have been cultivated. Corn was found in 20 stomachs, most of it taken in the winter and early spring months, so that it was waste grain, except that found in 2 stomachs in August and September, which was probably in the milk. A few other stomachs held what was thought to be grain of some kind, but was too finely ground for further identification. Grain of all kinds aggregates 1.66 per cent.

The poison Rhuses (*Rhus radicans*, *R. vernix*, *R. diversiloba*, and *R. toxicodendron*) seem to afford a favorite winter food for many birds. While the seeds themselves are so thoroughly protected by a hard, horny coating that they are seldom broken in the stomachs, they are overlaid by a white waxy pulp, which easily comes off, and is probably very nutritious. These seeds were found in 86 stomachs of the downy woodpecker, and they amount to 5.93 per cent of the food. Unfortunately they germinate freely after they have been voided, and probably these birds are the most efficient agents in distributing these noxious plants. Mast, i. e., acorns, beechnuts, chestnuts, hazelnuts, chinquapins, with a few other smaller seeds, amounts to 8.20 per cent of the food. This food is eaten in every month—the most in January and the least in July. A little cambium and some rubbish make up the remainder of the vegetable food, 2.31 per cent. The charge sometimes made that the downy injures trees by eating the inner bark is disproved. It eats cambium rarely and in small quantities.

The following seeds and fruits were found in the downy's food:

Bayberry (*Myrica carolinensis*).  
 Hornbeam (*Ostrya virginiana*).  
 Beech (*Fagus americanus*).  
 Oak (*Quercus* sp.).

Sorrel (*Rumex* sp.).  
 Smartweed (*Polygonum* sp.).  
 Pokeweed (*Phytolacca decandra*).  
 Blackberry or raspberry (*Rubus* sp.).

Mountain ash (*Sorbus americana*).  
 Juneberry (*Amelanchier canadensis*).  
 Poison ivy (*Rhus radicans*).  
 Poison oak (*Rhus diversiloba*).  
 Woodbine (*Parthenocissus quinquefolia*).  
 Flowering dogwood (*Cornus florida*).  
 Rough-leaved dogwood (*Cornus asperifolia*).

Alternate-leaved dogwood (*Cornus alternifolia*).  
 Mullein (*Verbascum thapsus*).  
 Elderberry (*Sambucus canadensis*).  
 Sunflower (*Helianthus* sp.).  
 Blueberry (*Vaccinium* sp.).

*Summary.*—The foregoing discussion of the food of the downy woodpecker shows it to be one of our most useful species. The only complaint against the bird is on the score of disseminating the poisonous species of *Rhus*. However, it is fortunate that the bird can live on this food when it is difficult to procure anything else. The insect food selected by the downy is almost all of species economically harmful.

### RED-CKOKADED WOODPECKER.

(*Dryobates borealis*.)

The red-cockaded woodpecker is an inhabitant of the Lower Austral zone of the Southeastern States from southern Virginia to eastern Texas and southern Missouri. Pine woods are its favorite haunts, and a large percentage of its food is obtained from pine trees. No complaints have yet been heard that this bird harms crops or forest trees, nor do the contents of its stomach indicate that such is the case. So far as known, it does not frequent orchards or cultivated land.

In the investigation of this bird's food 76 stomachs were available, taken in the four States of Alabama, Florida, Louisiana, and Texas. They were collected in every month except June and July. Of the total food 81.06 per cent was composed of insects, and the remainder, 18.94 per cent, of vegetable matter, mostly seeds of conifers.

*Animal food.*—Useful Coleoptera, i. e., carabids, were found in 7 stomachs, and amount to 0.53 per cent of the whole food. Other beetles, a large part of them the larvæ of wood-boring species, aggregate 10.49 per cent of the annual diet. Of these a number were weevils or snout beetles. Of the two identified beetles in the list which follows, the first belongs to the Chrysomelidæ or leaf-eating beetles; the other, *Trogosita virescens*, is one of the most beneficial species, since it preys upon the more destructive bark beetles and bark-boring grubs. Ants are evidently the favorite food. They were eaten in every month of which we have a record, and amount to a good percentage in each. December, with a percentage of 27.43, was apparently the month of least consumption, and September shows the maximum of 79 per cent, but we have hardly enough data to obtain final figures. The average for the year is 56.75 per cent, a record which is exceeded by that of only one other bird yet studied.

Hemiptera are eaten to the extent of 8.16 per cent of the food, and a good proportion of them are scales or bark lice. The others are mostly pentatomids or soldier-bugs. Nearly all were taken in the five months from December to April, inclusive, and two-thirds of them in December and January. These insects, and especially the pentatomids, are lovers of warm weather and sunshine, and many of them live on fruit. It seems probable that this bird gets them from their hibernating places. Grasshoppers, crickets, cockroaches, caterpillars, white ants (*Termes*), and spiders make up the rest of the animal food, 5.13 per cent. The cockroaches were in the form of their egg cases (oötheca).

The following is a list of insects identified in the stomachs:

COLEOPTERA.

*Gastroidea* sp.  
*Trogosita virescens*.

*Trogosita chloridea*.  
*Tomicus cacographus*.

HYMENOPTERA.

Ant (*Camponotus socius*).

Ant (*Cremastogaster laeviuscula*).

HEMIPTERA.

Green tree bug (*Nezara hiliaris*).

*Vegetable food*.—The greater part of the vegetable food consists of mast, mostly composed of the seeds of conifers. They were found in 26 of the 76 stomachs, and appear to be a somewhat regular article of diet, especially in the colder months. The total amount for the year is 11.13 per cent. Fruit pulp, poison-ivy seeds, bayberry seeds, seeds not identified, cambium, and rubbish each occurred in a few stomachs, and altogether amount to about 8 per cent of the food. Fruit pulp was found in 5 stomachs, but none of it could be further identified. Cambium was contained in 4 stomachs, and seeds of poison ivy in 1. Evidently this food has little economic interest.

The following seeds were identified in the food:

Bayberry (*Myrica carolinensis*).  
Poison ivy (*Rhus radicans*).

Magnolia (*Magnolia foetida*).  
Pine (*Pinus* sp.).

*Summary*.—From this brief review of the food of the red-cockaded woodpecker it is evident that it does little if any damage by eating products of husbandry, and that it does good work in the forest by devouring wood-boring larvæ. No doubt it aids in distributing the seeds of the pines upon which it feeds.

NUTTALL WOODPECKER.

(*Dryobates nuttalli*.)

This bird is much like the downy in its quiet demeanor, its lack of fear of man, and its unobtrusive industry in searching for food. It is only a trifle larger than the downy, and its foraging and nesting

habits are similar. Its range is practically confined to California, though it extends slightly beyond the boundaries at the northern and southern ends of the State.

The food of the Nuttall is much like that of the downy, the principal difference being in the relative proportions of the constituents. Only 53 stomachs of the Nuttall were available for examination—entirely too few to furnish final results, but enough to give an idea of the general character of the food. In the first analysis the food divides into 79.41 per cent of animal matter and 20.59 of vegetable. This differs but little from the record of the downy.

*Animal food.*—The largest item in the diet of the Nuttall consists of beetles of several families. The total for the year is 28.86 per cent. Of these the useful Carabidæ are barely represented. The remainder are divided among about a dozen families, of which the very harmful Cerambycidæ and Elateridæ in the larval stage are the most prominent. Ants amount to 8.19 per cent and are unevenly distributed, and the indications are that the stomachs are entirely too few to give trustworthy data on this item. Hymenoptera other than ants were eaten to the extent of 3.50 per cent. This again is not a reliable result, as nearly all of them were found in one stomach taken in December. Hemiptera, or bugs, amounted to 14.76 per cent. A few of these were scales and plant lice, but the majority were of the larger species. Two stomachs contained each between 30 and 40 box-elder bugs (*Leptocoris trivittatus*). These insects have a way of becoming very abundant at times and making a nuisance of themselves by invading buildings in search of winter quarters. Caterpillars stand third in the dietary of the Nuttall woodpecker and are eaten more regularly than any other food except beetles. They amount to 14.21 per cent. No special pest was identified, but some were evidently wood-boring species. A few flies, raphidians, pseudoscorpions, spiders, and millepeds make up the rest of the animal food, 9.89 per cent.

Following is a list of insects identified in the stomachs of the Nuttall:

#### COLEOPTERA.

*Glyptoscels albidus.*  
*Gastroidea* sp.

*Blapstinus* sp.  
*Balaninus* sp.

#### HEMIPTERA.

*Sinea diadema.*

*Leptocoris trivittatus.*

#### ISOPTERA.

White ant (*Termes* sp.).

*Vegetable food.*—Fruit was eaten to the extent of 8.49 per cent. It was found in 15 stomachs, of which 2 contained rubus seeds; 5, elderberries; and the rest, pulp not further identified, except that

in 1 stomach it was thought to be apple. Flower buds were found in 1 stomach. Poison oak (*Rhus diversiloba*) was noted in 9 stomachs, mast in 5, cambium in 2, and rubbish, etc., in 5. Altogether they amounted to 12.10 per cent, and made up the quota of vegetable food. None of them was eaten to a sufficient extent to be of any economic interest.

The following fruits were found in the stomachs:

Blackberry or raspberry (*Rubus* sp.).      Poison oak (*Rhus diversiloba*).  
Elderberry (*Sambucus glauca*).

*Summary.*—In its animal food the Nuttall woodpecker is beyond criticism. Practically all of the insects eaten are either pests or of no positive benefit. While some fruit is eaten, it consists largely, and perhaps entirely, of wild varieties. Probably the worst that can be said of the bird is that it helps in the distribution of poison-oak seeds.<sup>1</sup>

### THREE-TOED WOODPECKERS.

(*Picoides arcticus* and *P. americanus*.)

The three-toed woodpeckers are residents of the Boreal zones of North America, in Alaska, Canada, the northeastern United States, and in the mountains of the Western States, south to southern New Mexico and to central California. The two species, including the two subspecies of *americanus*, are so similar in habits that they may be treated together. All are residents of coniferous forests, from which they sometimes wander a short distance in winter. The trunks of scaly-barked conifers, such as spruces, hemlocks, tamaracks, and lodgepole pines, are their favorite hunting grounds, and here they excavate burrows in which they rear their young and find shelter at night.

In their choice of food these two species are as closely allied as in other respects. The great bulk consists of the larvæ of wood-boring beetles or moths. These are eaten with great regularity throughout the year, but somewhat more in the colder months than in summer. In the dead of winter, when all insect life is apparently quiescent, these birds still obtain their daily food. Flies and bees no longer sport in the sunshine; butterflies and flowers are replaced by sleet and snow; the beetles are either dead or snugly ensconced in crevices in the bark, awaiting the return of warmth, while the larvæ repose in their burrows of solid wood, apparently safe from all disturbance. But undaunted by cold and undeterred by hard work, our intrepid little friends tear open the secure retreats in the bark, or chisel into the solid wood, and feast upon the luckless insects.

Unfortunately only 28 stomachs of *Picoides arcticus* and 23 of *P. americanus* were available for examination. There are few birds

<sup>1</sup> Another species of *Dryobates* (*D. arizonæ*), of which no stomachs have been received, inhabits the mountains from northeastern Arizona and northwestern New Mexico south into Mexico.

which eat more of the pests of the forests than do the three-toed woodpeckers; and while we have no doubt determined the principal food factors, there are many minor questions for the solution of which additional material is necessary.

In the first analysis the food divides into 88.69 per cent of animal matter to 11.31 of vegetable for *arcticus*, and 94.06 per cent of animal to 5.94 of vegetable for *americanus*. The largest item with both species is wood-boring coleopterous larvæ. These amount to 64.25 per cent with *arcticus* and 60.66 with *americanus*. Caterpillars, which in this case are mostly wood-boring species, amount to 12.88 and 14.45 per cent for the two birds respectively. The total of wood-boring larvæ, including both caterpillars and beetles, is 77.13 per cent for *arcticus* and 75.11 per cent for *americanus*, or more than three-fourths of the food of each species. Stomachs containing 15 to 20 of these grubs are very common, and one held 34. Probably the stomach is filled several times each day, and it does not seem unreasonable to assume that a bird will eat 50 of these insects every 24 hours for 6 months and at least 25 daily for the other half of the year. At this rate one bird will annually destroy 13,675 of these destructive grubs. If this assumption be true, the birds of these two species must destroy an immense quantity of wood-boring insects, even if they do not cause any perceptible diminution in their numbers. Beetles other than wood-borers amount to 3.41 per cent for *arcticus* and 10.39 for *americanus*. A considerable proportion of these were weevils, including quite a number of engravers (Scolytidæ). They are, however, eaten so irregularly as to indicate that they are taken only incidentally and are not sought, as are the wood-boring grubs. Ants constitute 6.35 per cent of the food of *arcticus* and 8.29 of that of *americanus*. None of these were taken in winter, and most of them were eaten in spring and summer. The Picoides do not belong to the ant-eating group of woodpeckers. A few other insects and spiders amount to less than 1 per cent for each species and make up the remainder of the animal food.

*Vegetable food.*—Vegetable matter constitutes 11.31 per cent of the stomach contents of *arcticus* and 5.94 per cent of that of *americanus*. It can all be included in four items: Fruit, mast, cambium, and rubbish. Fruit skins were found in only 1 stomach of *americanus* and mast in but 1 stomach of *arcticus*. Cambium was found in 10 stomachs of *arcticus* and 8 of *americanus*. This indicates that these birds do some pecking at the bark of living trees for other purposes than getting insects, but no complaints have yet been made, from which we infer that little or no damage is done; in fact the amount contained in the stomachs is not large, a little less than 10 per cent. Rubbish, consisting principally of rotten wood, was found in 9

stomachs. Where a bird pecks wood as much as do these, it is no wonder that some of it is swallowed with the grubs that are embedded therein.

*Summary.*—The foregoing discussion of the food of the two species of *Picoides* shows that these birds act as “conservators of the forest” in the strongest sense. Three-fourths of their food consists of the direst enemies of forest trees. In the Report on Forest Insects by the United States Entomological Commission, some 25 species of cerambycid and buprestid beetles are noted as preying upon the ash tree and 35 upon the pine. Since the family Cerambycidae contains upward of 7,500 species, of which 600 are found in America, since all pass their larval stage within the substance of some tree or woody plant, and since many remain in the larval state two or three years, evidently they inflict upon forest trees and other plants an immense amount of damage. Probably there are not many other agencies more destructive to timber than this family of beetles. Nor is timber safe even after it has been cut. Logs lying in the mill yard or forest may be ruined in a single season if these creatures are not prevented from depositing their eggs. So long do some of these larvæ live in the wood that they sometimes emerge after it has been converted into furniture and passed into household use. A very efficient check upon the undue increase of these insects is found in the woodpeckers, especially the two species of *Picoides*. In orchards, or in parks, it may be easy to combat insect enemies by insecticides or other artificial means, but in the forest this is more difficult and expensive, and it behooves the forester to take advantage of all helpers which Nature has provided; among these, insectivorous birds must take high rank. It is unfortunate that in most places three-toed woodpeckers are not as numerous as many other species, and for this reason they should be protected and encouraged in every possible way.

#### YELLOW-BELLIED WOODPECKER OR SAPSUCKER.

(*Sphyrapicus varius* and subsp.)

The yellow-bellied woodpecker or sapsucker (Pl. II) is probably the most migratory of all our woodpeckers. It breeds throughout the whole of southern Canada from ocean to ocean and thence southward to northeastern California, western Texas, northern Missouri, northern Ohio, and Massachusetts, and in the mountains south to North Carolina. It winters from near the southern limit of the breeding range south to Mexico, Cuba, and Costa Rica.

It is to this species that the term sapsucker is most often and most justly applied, for it drills holes in the bark of certain trees and drinks the sap. It feeds also on cambium, insects, and wild fruits and berries.

In writing of the habits of these woodpeckers in northern New York, in 1878, Dr. Merriam states:

They really do considerable mischief by drilling holes in the bark of apple, thorn-apple, and mountain ash trees in such a way as to form girdles of punctures, sometimes 2 feet or more in breadth (up and down), about the trunks and branches. \* \* \* The holes, which are sometimes merely single punctures, and sometimes squarish spaces (multiple punctures) nearly half an inch across, are placed so near together that not infrequently they cover more of the tree than the remaining bark. Hence, more than half of the bark is sometimes removed from the girdled portions, and the balance often dries up and comes off. Therefore it is not surprising that trees which have been extensively girdled generally die, and mountain ash are much more prone to do so than either apple or thornapple trees, due, very likely, to their more slender stems.<sup>1</sup>

The late Frank Bolles has published some interesting detailed observations respecting the food habits of the sapsucker. His conclusions are:

That the yellow-bellied woodpecker is in the habit for successive years of drilling the canoe birch, red maple, red oak, white ash, and probably other trees, for the purpose of taking from them the elaborated sap, and in some cases parts of the cambium layer; that the birds consume the sap in large quantities for its own sake and not for insect matter which such sap may chance occasionally to contain; that the sap attracts many insects of various species, a few of which form a considerable part of the food of this bird, but whose capture does not occupy its time to anything like the extent to which sap drinking occupies it; \* \* \* that the forest trees attacked by them generally die, possibly in the second or third year of use.<sup>2</sup>

Mr. Bolles shot 8 sapsuckers in July and August, 1890. Their stomachs "were well filled with insects." Some of these were examined by Mr. Samuel H. Scudder, who states:

The insects in the different stomachs are in all cases almost exclusively composed of the harder chitinous parts of ants. In a cursory examination I find little else, though one or two beetles are represented, and No. 4 must have swallowed an entire wasp of the largest size, his head and wings attesting thereto.<sup>3</sup>

Mr. Bolles proved by experiment that concentrated sap (saturated with sugar) is not sufficient to sustain life, even with the addition of a small percentage of insects. The logical inference is that sap, while liked by the birds and consumed in large quantities, holds a subordinate place as an article of food.

J. Maurice Thompson says of the sapsucker:

Its food is sap or juices of green trees. It eats nothing else. \* \* \* The principal trees from which it obtains its food are the maples, hickories, cedar, apple, pear, southern pine, and swamp ash.<sup>4</sup>

In speaking of this species Dr. Hopkins mentions the finding of a small pitch pine tree that had recently died from injuries by woodpeckers. The bird evidently attacks the healthy tree for the sole

<sup>1</sup> Bull. Nuttall Ornith. Club, IV, 3-5, January, 1879.

<sup>2</sup> Auk, VIII, 270, July, 1891.

<sup>3</sup> Auk, VIII, 269, July, 1891.

<sup>4</sup> Appleton's Journal, VIII, 631, Dec. 7, 1872.

purpose of feeding on the inner bark. Thus, instead of destroying insects, it made the conditions favorable for the attack of bark beetles and other insects which had bred in the bark and wood in considerable numbers. To anticipate the possible conclusion that the woodpecker intended to thus trap the insects and return to eat them, Dr. Hopkins added that at the time the observations were made, the insects had not been molested.<sup>1</sup>

This investigation of the food of the yellow-bellied sapsucker is based upon examination of the contents of 313 stomachs, collected in 24 States, Canada, and the District of Columbia, and distributed over 12 months of the year. Of this food 49.31 per cent is animal matter and 50.69 vegetable. This is the first species discussed in which the vegetable part of the diet is greater than the animal. This is true of 5 of the 16 species under consideration.

*Animal food.*—Useful beetles, i. e., predaceous ground beetles and ladybirds (Coccinellidæ), are eaten by the sapsucker to the extent of only 0.91 per cent of the whole food. Other beetles amount to 4.54 per cent, and are made up of weevils, dung beetles (*Aphodius*), and click beetles, with a few cerambycid larvæ. Ants amount to 34.31 per cent of the whole food, or 69 per cent of the animal part. They are evidently favorite food, being eaten quite regularly through the year, although the months from May to August, inclusive, show the highest percentages, averaging over 68 per cent. Other Hymenoptera amount to 2.64 per cent, and are very irregularly taken. October appears to be the month of greatest consumption, with 15.07 per cent. Hemiptera are eaten very sparingly. Scales (Coccidæ) were found in two stomachs, and in one were identified as the plum scale (*Eulecanium cerasifex*); these, with a few stink bugs, amount to a little less than 1 per cent for the year. A few miscellaneous insects and spiders aggregate 5.44 per cent. The insects consist of May flies, stone flies, grasshoppers, crickets, tree hoppers, caterpillars and moths, and flies (Diptera). A few eggs were found, probably those of the tent caterpillars (*Malacosoma*).

The following is a list of insects identified in the stomachs:

#### COLEOPTERA.

<i>Coccinella 9-notata.</i>	<i>Aphodius inquinatus.</i>
<i>Coccinella sanguinea.</i>	<i>Dichelonycha</i> sp.
<i>Adalia bipunctata.</i>	<i>Xanthonia 10-notata.</i>
<i>Anatis</i> sp.	<i>Diabrotica 12-punctata.</i>
<i>Læmophlæx biguttatus.</i>	<i>Canifa pallipes.</i>
<i>Onthophagus</i> sp.	<i>Pandeletejus hiliaris.</i>
<i>Aphodius fimetarius.</i>	<i>Balaninus</i> sp.

#### HYMENOPTERA.

<i>Vespa maculata.</i>	<i>Pimpla</i> sp.
<i>Vespa arenaria.</i>	

<sup>1</sup> Hopkins, A. D., Bull. 56, West Virginia Agric. Exper. Sta., p. 355, 1890.

## HEMIPTERA.

Plum or cherry scale (*Eulecanium cerasifex*).

## LEPIDOPTERA.

Tent caterpillar (*Malacosoma* sp.).

*Vegetable food.*—The two principal items of vegetable food are fruit and cambium. Twenty-two species of wild fruit and two of cultivated were identified. In general the least fruit is eaten in spring and summer and the most in fall and winter. Altogether it was found in 118 stomachs, none in May and the most, 71.26 per cent, in November. It was evidently mainly berries left on the bushes. Seeds of *Rubus* fruit, which may be either wild or cultivated, were found in two stomachs, and two contained what was thought to be apple pulp. The total of the fruit is 28.06 per cent of the food, but evidently has little economic interest. The apple was probably the only cultivated variety and this was eaten only twice. Cambium, or the inner bark of trees, was eaten every month, but mostly in winter and spring. The greatest consumption is in April, 48.95 per cent, and the least in November, 1.53 per cent. It was found in 127 stomachs and was the entire contents of 12. The average for the year is 16.54 per cent, which is exceeded by only two items—fruit and ants. The subjects of cambium and sap sucking have been discussed on a previous page. Mast, poison *Rhus* seeds, mullein, and rubbish collectively make up the remaining 6.09 per cent. Mast was found in 15 stomachs, and is evidently not specially sought. Poison ivy seed was contained in seven stomachs and poison sumac in one, so the sapsucker does little harm by distributing the seed of these noxious plants. Rubbish was found in 48 stomachs. It was mostly bits of the outer bark of trees, evidently swallowed when pecking for cambium.

The following fruits and seeds were found in the food:

Red cedar ( <i>Juniperus virginiana</i> ).	Black alder ( <i>Ilex verticillata</i> ).
Greenbrier ( <i>Smilax</i> sp.).	Burning bush ( <i>Euonymus americanus</i> ).
Hackberry ( <i>Celtis occidentalis</i> ).	Frost grape ( <i>Vitis cordifolia</i> ).
Sassafras ( <i>Sassafras sassafras</i> ).	Virginia creeper ( <i>Parthenocissus quinquefolia</i> ).
Blackberry or raspberry ( <i>Rubus</i> sp.).	Flowering dogwood ( <i>Cornus florida</i> ).
Shad or service berry ( <i>Amelanchier canadensis</i> ).	Sour gum ( <i>Nyssa sylvatica</i> ).
Choke cherry ( <i>Prunus virginiana</i> ).	Blueberry ( <i>Vaccinium</i> sp.).
Black cherry ( <i>Prunus serotina</i> ).	Black nightshade ( <i>Solanum nigrum</i> ).
Poison sumac ( <i>Rhus vernix</i> ).	Mullein ( <i>Verbascum thapsus</i> ).
Poison ivy ( <i>Rhus radicans</i> ).	Red-berried elder ( <i>Sambucus pubens</i> ).
American holly ( <i>Ilex opaca</i> ).	Elder ( <i>Sambucus</i> sp.).
Ink berry ( <i>Ilex glabra</i> ).	Poke berry ( <i>Phytolacca decandra</i> ).
Swamp holly ( <i>Ilex decidua</i> ).	

*Summary.*—In the animal food of the yellow-bellied sapsucker, ants are the most important item, and while of no great economic

interest they must be reckoned in the bird's favor. On the other hand, the damage this sapsucker inflicts in eating the cambium and sap of trees is so serious that it more than counterbalances any good that the bird does in other directions. Investigations show that the damage to timber, especially in the Southern States, is extensive and serious.<sup>1</sup>

#### RED-BREASTED SAPSUCKER.

(*Sphyrapicus ruber* and subsp.)

The red-breasted sapsucker is confined to the Pacific coast region, and ranges from central Lower California in winter, north in summer through California, Oregon, and Washington to Alaska. Naturally it seems to be a forest bird, but it takes kindly to orchards and ranches. It is migratory to a slight extent, but summers as far south as the San Bernardino Mountains. It makes, however, a minor migration in many localities by descending the mountains to the valleys, in which it winters.

Speaking guardedly of this bird, Maj. Charles Bendire says:

I am inclined to think that this species does not indulge in the habit of girdling trees for the sap and the soft inner bark (cambium) to the same extent that *Sphyrapicus varius* does; at any rate, not during the breeding season.<sup>2</sup>

On the other hand, Prof. Cook, of Claremont, California, gives the following direct testimony:

*Sphyrapicus ruber* is the sapsucker of southern California. It taps fruit trees, especially prune and apricot, and evergreens. Its mischief seems much more serious than that of its congener of the East, as trees are frequently killed by reason of its punctures, although these latter are more distant and less numerous. I never knew a tree to be killed by the sapsuckers in Michigan. The evil in California is wrought in summer, when the dry season has enfeebled the tree, and this is a possible explanation of the more serious harm to the trees of this region.<sup>3</sup>

In the face of this conflicting testimony we may infer that the habits of the bird vary with the locality.

In Oregon the writer observed trees of white birch and mountain ash growing in a village yard which were badly injured by this bird.

Only 34 stomachs of this species were available for examination, and none were taken in the months from April to August, inclusive, while 29, or five-sixths of all, were collected in October, November, and December. Only some general ideas of the food can be expected from so little material.

In the first analysis we find practically 69 per cent of animal food to 31 of vegetable.

*Animal food.*—This species is a much greater insect eater than *S. varius*. Ants, the largest item, amount to 42.49 per cent. They

<sup>1</sup> A bulletin upon this subject is in preparation by W. L. McAtee.

<sup>2</sup> Bendire, Maj. Charles, *Life Histories of North American Birds*, II, 94, 1896.

<sup>3</sup> Cook, A. J., *Auk*, XIII, 85, 1896.

were eaten freely in every month in which stomachs were taken except February, and 4 stomachs contained nothing else. Other Hymenoptera aggregate a little more than 7 per cent. Beetles of all kinds amount to only 4 per cent, and none of them are of useful species. The greater number belong to the family Chrysomelidæ, or leaf-eaters. *Diachus auratus* was the only one identified. One stomach contained the remains of *Rhinosimus pallipes*, a member of the Pythidæ, a small and rather rare family. Caterpillars were found in 2 stomachs, locust eggs in 1, and a caterpillar formed the entire contents of 1. All these amount to 15 per cent, and make up the rest of the animal food.

*Vegetable food.*—Of the vegetable food, fruit constitutes 12.69 per cent. Berries of the pepper tree (*Schinus molle*) were found in 3 stomachs, cascara (*Rhamnus californicus*) in 1, pulp not further identified in 3, and figs in 1. Only the last is of any economic importance. Seeds of poison oak were found in 4 stomachs, wax myrtle (*Myrica californica*) in 1, and unidentified seeds in 1. Seeds altogether amount to 5.96 per cent. Cambium was found in only 6 stomachs, but aggregated 11.13 per cent, which is three-fourths as much as was eaten by *S. varius*. Nearly all that had taken it at all had eaten a good percentage. Stomach examinations alone do not enable us to settle the status of the bird, for which more material and some field observation will be necessary.

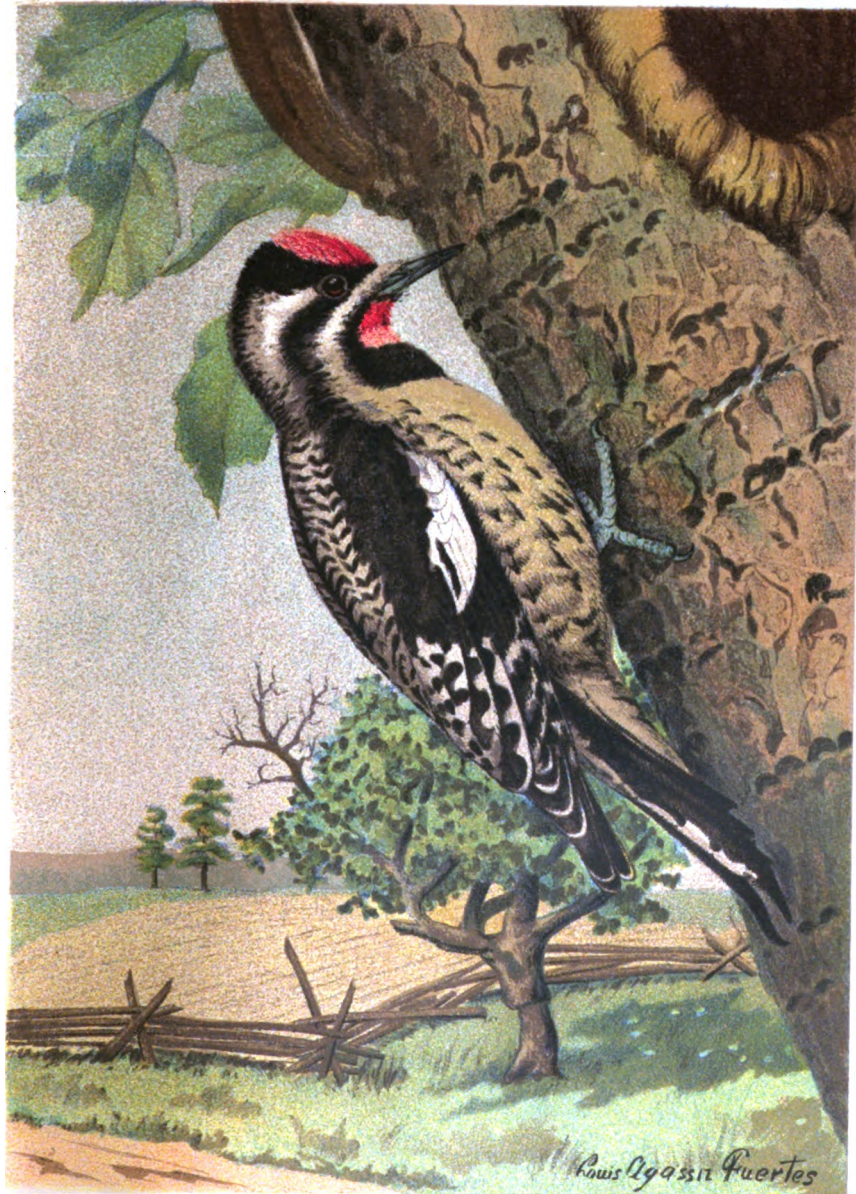
*Summary.*—It appears that the red-breasted sapsucker attacks and injures trees, but whether it is as destructive as its eastern relative is not yet known, and more material and further observations are necessary to settle the question.

#### WILLIAMSON SAPSUCKER.

(*Sphyrapicus thyroideus*.)

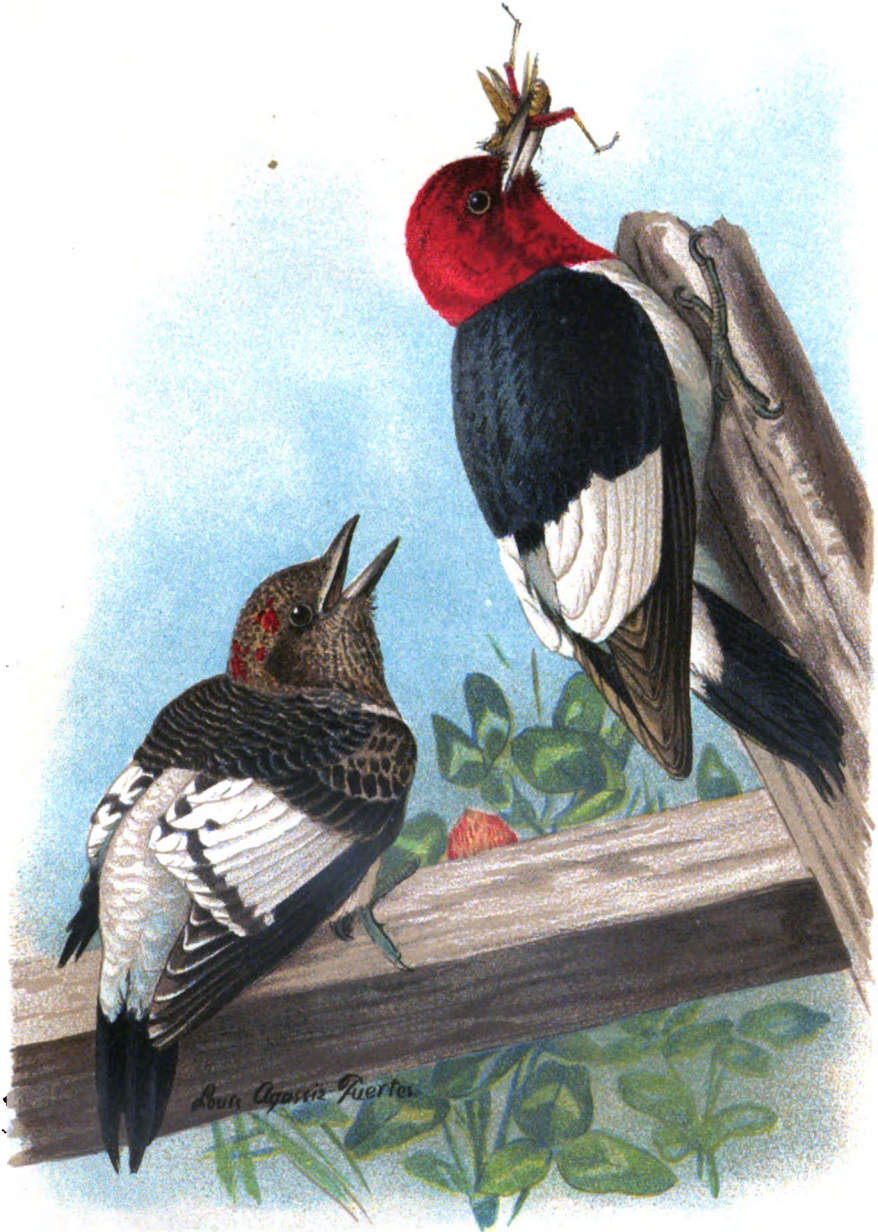
The Williamson sapsucker is a bird of mountains and evergreen forests. Its range extends from the eastern slope of the Rocky Mountains westward to the Pacific, and from Arizona and New Mexico northward to British Columbia; south in winter to Mexico. The bird is likely to be of little economic interest except in connection with forests. Only 17 stomachs of this species have been received by the Biological Survey, and all but 2 of these were collected in the months from June to September, inclusive. Conclusions based on the examination of so little material must be considered as only tentative. In the first analysis of the food it divides into 87 per cent of animal matter and 13 of vegetable.

*Animal food.*—Of the animal food a mere trace was shown of click-beetles (Elateridæ) and less than 1 per cent of crane flies (Tipulidæ). The remainder, 86 per cent, consists entirely of ants, with which 7 stomachs were entirely filled. This record places this bird at the



YELLOW-BELLIED SAPSUCKER.





RED-HEADED WOODPECKER (ADULT AND YOUNG).



head of the woodpeckers in ant eating, but the material is too scanty to warrant final conclusions.

*Vegetable food.*—Fruit pulp in 1 stomach and rubbish in another, each amounted to less than 1 per cent of the year's food. Cambium occurred in 5 stomachs, and formed the bulk of the vegetable food, 12.55 per cent of the whole.

*Summary.*—These results would indicate a very limited diet for this bird, but it is altogether probable that a greater number of stomachs would materially modify these figures. They show, however, that the bird eats ants and cambium, if they are not conclusive as to what it does not eat.

### PILEATED WOODPECKER.

(*Phlæotomus pileatus* and subsp.)

The pileated woodpecker, logcock, woodcock, or cock of the woods, as it is variously called, is the largest member of the family now living in the United States, except the ivory-billed woodpecker, which is very rare. The logcock is essentially a forest bird, and is rarely found except in rather extensive tracts of timber. It is usually shy and retiring, difficult to approach, and better known by its work than by sight. Its large size, loud voice, and habit of hammering upon dead limbs combine to make it a conspicuous inhabitant of the forest. Its strength is wonderful, and it is hard to believe that a bird can so completely destroy a stump or log. Strips of decayed wood 2 feet long, 4 inches wide, and an inch thick are often torn from a stump and thrown several yards away.

Woodpeckers signal each other by hammering upon a dead and hollow limb or trunk of a tree, or upon the metallic cornice of a building. The pileated is an adept at such telegraphing, and its tattoo on a particularly resonant piece of timber can be heard for more than a mile.

The pileated woodpecker seems to be distributed over the United States in general, and north to Canada, but is absent from some large areas, particularly in the southwestern United States, even where there are extensive forests and other conditions apparently suited to its tastes. It is not migratory in the usual sense, but in winter wanders extensively, usually accompanied by its mate, which leads to the belief that it mates for life.

In the laboratory investigation of this bird's food 80 stomachs were available. They were collected in 14 States, the District of Columbia, and Canada, and are distributed in every month, though May is represented by only 1. The animal food amounts to 72.88 per cent and the vegetable to 27.12. The former consists principally of beetles and ants, and the latter of wild fruits.

- *Animal food*.—Beetles amount to 22.01 per cent. Nearly all were in the larval stage, and evidently were dug out of dead and decaying wood. They belong to the Cerambycidae, the Buprestidae, and the Elateridae, all of them wood-borers, with some Lucanidae and Scarabaeidae, many species of which breed in rotting timber. Carabidae, or useful ground-beetles, were found in only 6 stomachs and amount to a small fraction of 1 per cent.

Ants aggregate 39.91 per cent and constitute more than half of the animal food. They were found in 48 stomachs, and in one, 2,600 were counted; in another, 2,080; and in a third, 2,000. They are mostly of the larger species that live in decaying timber. These two items, beetles and ants, make up the bulk of the animal food, 61.92 per cent. It is evident that they are the objects of the bird's search when he is foraging over the trunks of dead trees or logs, and that other insects are taken only incidentally. Flies, caterpillars, fragments of cockroaches and their egg cases (ootheca), bits of grasshoppers, some sawflies, and white ants, no one of which amounts to a respectable percentage, aggregate 10.96 per cent, the balance of the animal food.

The following is a list of insects identified in the stomachs:

#### COLEOPTERA.

<i>Anisodactylus</i> sp.	<i>Upis ceramboides</i> .
<i>Allorhina nitida</i> .	<i>Chalcophora</i> sp.
<i>Cyclocephala</i> sp.	

#### HYMENOPTERA (ANTS).

<i>Camponotus pennsylvanicus</i> .	<i>Cremastogaster laeviscula</i> .
<i>Camponotus herculeanus</i> .	

#### LEPIDOPTERA.

Caterpillar (*Scollocampa liburna*).

*Vegetable food*.—The largest item of vegetable food, and in fact the only one of importance, is wild fruit, which amounts to 22.56 per cent, and of which 19 species were identified. This is probably eaten in every month, but in the stomachs examined none was found in April, May, or June; but as only 6 stomachs were collected in those months, the record is not conclusive. The only part of the fruit which can possibly have any economic interest is some *Rubus* seeds found in 1 stomach and some unidentified seeds in 5, but probably these were wild like the others. Seeds of poison ivy (or poison oak), poison sumac, dwarf sumac, a little cambium, and mast, with some rubbish, altogether amount to 4.56 per cent and complete the vegetable food.

The following vegetable food was found in the stomachs:

Greenbrier ( <i>Smilax glauca</i> ).	Frost grape ( <i>Vitis cordifolia</i> ).
Cat brier ( <i>Smilax rotundifolia</i> ).	Woodbine ( <i>Parthenocissus quinquefolia</i> ).
Laurel-leaved greenbrier ( <i>Smilax laurifolia</i> ).	Flowering dogwood ( <i>Cornus florida</i> ).
Hackberry ( <i>Celtis occidentalis</i> ).	Rough-leaved dogwood ( <i>Cornus asperifolia</i> ).
Sassafras berry ( <i>Sassafras sassafras</i> ).	Sour gum ( <i>Nyssa sylvatica</i> ).
Blackberry or raspberry ( <i>Rubus</i> sp.).	Tupelo gum ( <i>Nyssa aquatica</i> ).
Dwarf sumac ( <i>Rhus copallina</i> ).	Persimmon ( <i>Diospyros virginiana</i> ).
Poison sumac ( <i>Rhus vernix</i> ).	Fringe tree ( <i>Chionanthus virginica</i> ).
Poison ivy ( <i>Rhus radicans</i> ).	Elderberry ( <i>Sambucus canadensis</i> ).
American holly ( <i>Ilex opaca</i> ).	Larger withe-rod ( <i>Viburnum nudum</i> ).
Dahoon holly ( <i>Ilex cassine</i> ).	Black haw ( <i>Viburnum prunifolium</i> ).

*Summary.*—The food of the pileated woodpecker does not interest the farmer or horticulturist, for it is obtained entirely from the forest or the wild copses on its edge. This bird does not visit either the orchard or the grain field, and all its work in the forest helps to conserve the timber. Unfortunately the bird is so scarce in many places that it is an object of curiosity, and the man or boy with a gun never lets pass a chance to shoot one, although its flesh is unfit for food. In fall and winter it may often be seen in the market in Washington, and probably in cities farther south. Maj. Bendire relates that once when short of provisions he attempted to eat one, but found it extremely unpalatable. Its killing should be strictly prohibited at all times.

#### RED-HEADED WOODPECKER.

(*Melanerpes erythrocephalus*.)

The handsome redhead (Pl. III) inhabits suitable localities throughout most of southern Canada and the United States east of the Rocky Mountains, but is rare in New England and northeastward. It is a familiar bird on telegraph poles and fence posts and feeds largely on insects found upon these bare surfaces, but the vegetable matter in its stomach shows that it forages elsewhere also.

Fifty years ago Giraud stated that on Long Island the red-headed woodpecker arrives early in April, and during the spring "subsists chiefly on insects. In summer it frequents fruit trees, ripe cherries and pears seeming to be a favorite repast. In the fall it feeds on berries and acorns, the latter at this season forming a large portion of its food."<sup>1</sup>

In its fondness for mast it resembles its relative, the California woodpecker. In the northern part of its range, where the oak is replaced by the beech, the redhead makes the beechnut its principal food. Dr. C. Hart Merriam has given much testimony under this head.<sup>2</sup> He states that in northern New York, where it is one of the

<sup>1</sup> Giraud, J. P., *Birds of Long Island*. p. 180, 1844.

<sup>2</sup> *Birds of Connecticut*, p. 66, 1877; *Bull. Nuttall Ornith. Club*, III, 124, 1878; *Mammals of the Adirondacks*, p. 226, 1884.

commonest woodpeckers, it subsists almost exclusively on beechnuts during the fall and winter, even picking the green nuts before they are ripe and while the trees are still covered with leaves. He has shown that these woodpeckers invariably remain throughout the winter after good nut yields and migrate whenever the nut crop fails. He says: "Gray squirrels, red-headed woodpeckers, and beechnuts were numerous during the winters of 1871-72, 1873-74, 1875-76, 1877-78, 1879-80, 1881-82, 1883-84, while during the alternate years the squirrels and nuts were scarce and the woodpeckers altogether absent;" and adds that in Lewis County, N. Y., "a good squirrel year is synonymous with a good year for *Melanerpes*, and vice versa." In early spring following a nut year, when the melting snow uncovers the ground, they feed on the beechnuts that were buried during the winter. On April 5, 1878, at Locust Grove, N. Y., he shot 6 whose gizzards contained beechnuts and nothing else.

In an interesting article in the *Auk*,<sup>1</sup> Mr. O. P. Hay says that in central Indiana during a good beechnut year, from the time the nuts began to ripen, the redheads were almost constantly on the wing, passing from the beeches to some place of deposit. They hid the nuts in almost every conceivable situation. Many were placed in cavities in partly decayed trees; and the felling of an old beech was certain to provide a feast for the children. Large handfuls were taken from a single knot hole. They were often found under a patch of raised bark, and single nuts were driven into cracks in the bark. Others were thrust into cracks in gateposts; and a favorite place of deposit was behind long slivers on fence posts. In a few cases grains of corn were mixed with beechnuts. Nuts were often driven into cracks in the ends of railroad ties, and the birds were often seen on the roofs of houses pounding nuts into the crevices between the shingles. In several instances the space formed by a board springing away from a fence was nearly filled with nuts, and afterwards pieces of bark and wood were brought and driven over the nuts as if to hide them from poachers.

In summer Dr. Merriam has seen the redheads "make frequent sallies into the air after passing insects, which were almost invariably secured." He has also seen them catch grasshoppers on the ground in a pasture.

Dr. A. K. Fisher saw several red-headed woodpeckers feeding on grasshoppers in the streets at Miles City, Mont., in the latter part of July, 1893. Several of the birds were seen capturing these insects near the hotel throughout the greater part of the forenoon. From a regular perch on top of a telegraph pole or cottonwood they descended on their prey, sometimes eating them on the ground, but more often returning to their former post to devour them.

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<sup>1</sup> *Auk*, IV, 194, 195, 1887.

The following interesting observation was made by Dr. G. S. Agersborg, of Vermilion, S. Dak.:<sup>1</sup>

Last spring, in opening a good many birds of this species with the object of ascertaining their principal food, I found in their stomachs nothing but young grasshoppers. One of them, which had its headquarters near my house, was observed making frequent visits to an old oak post, and on examining it I found a large crack where the woodpecker had inserted about 100 grasshoppers of all sizes (for future use, as later observation proved), which were put in without killing them, but they were so firmly wedged in the crack that they in vain tried to get free. I told this to a couple of farmers, and found that they had also seen the same thing, and showed me posts which were used for the same purpose. Later in the season the woodpecker whose station was near my house commenced to use his stores, and to-day (February 10) there are only a few shriveled-up grasshoppers left.

The late Mr. Charles Aldrich, of Webster City, Iowa, states that he saw a red-headed woodpecker catching grasshoppers on the prairie half a mile from timber. In Nebraska grasshoppers were found in 4 out of 6 stomachs examined by Prof. Samuel Aughey.

Besides taking fruit and grain, this woodpecker has been accused of destroying the eggs of other birds and even of killing the young; and from Florida comes a report that it enters poultry houses and sucks the eggs of domestic fowls. Mr. Charles Aldrich, of Webster City, Iowa, says that a red-headed woodpecker was seen to kill a duckling with a single blow on the head, and then to peck out and eat the brains.<sup>2</sup> In view of such testimony, remains of eggs and young birds were carefully looked for in the stomachs examined, but pieces of eggshell were found in only 4.

A very unusual trait has been recorded by Dr. Howard Jones, of Circleville, Ohio. He has seen the red-headed woodpecker steal the eggs of eaves swallows, and in cases where the necks of the nests were so long that the eggs were out of reach, the woodpecker made a hole in the walls of the nest and so obtained the contents. In a colony of swallows containing dozens of nests, not a single brood of young was raised. One of the woodpeckers also began to prey upon hens' eggs, and was finally captured in the act of robbing the nest of a sitting hen.<sup>3</sup>

The redhead has been accused of doing considerable damage to fruit and grain, and both charges are fairly well sustained. In northern New York Dr. Merriam has seen it peck into apples on the tree, and has several times seen it feed on chokecherries (*Prunus virginiana*).

Mr. August Jahn, of Pope County, Ark., writes that it has damaged his corn to the amount of \$10 or \$15, and Dr. J. R. Mathers, of Upshur County, W. Va., says that the same species feeds on cherries, strawberries, raspberries, and blackberries, and that its depredations are

<sup>1</sup> Bull. Nuttall Ornith. Club, III, 97, 1878.

<sup>2</sup> Am. Nat., VI, 308, May, 1877.

<sup>3</sup> Ornithologist and Oologist, VIII, 56, 1883.

sometimes serious. According to Mr. Witmer Stone, of Germantown, Pa., red-headed woodpeckers have been observed to strip a black-berry patch of all of its fruit. Mr. W. B. McDaniel, of Decatur County, Ga., also reports that the sapsucker and redhead eat grapes and cherries, the loss being sometimes considerable. These examples show the nature of the testimony contributed by eyewitnesses, the accuracy of whose observations there is no reason to doubt. That the stomach examinations do not reveal more damaging evidence against the species is not surprising, for a person seeing a bird eating his choice fruit, or in some other way inflicting damage, is more impressed by it than by the sight of a hundred of the same species quietly pursuing their ordinary vocations. Thus an occasional act is taken as a characteristic habit.

In the food investigation of the redhead 443 stomachs were examined. They were collected in 27 States, the District of Columbia, and Canada, and represent every month, though fewer were taken in the colder season, as the bird is inclined to migrate, and remains in the north only when an abundance of food is assured. Of the stomach's contents, animal matter amounts to 33.83 per cent and vegetable to 66.17.

*Animal food.*—Beetles amount to about 19 per cent of the food. Of these, 7.34 per cent consist of predaceous ground beetles and tiger beetles, with a few ladybird beetles, all of which are useful. This is the highest percentage of useful insects eaten by any of the woodpeckers. Among the species taken are the fire ground-beetle (*Calosoma calidum*) and the searcher (*C. scrutator*), both predaceous species of large size and vile odor.

*Passalus cornutus*, one of the staghorns, a large species, was also found, as well as a pair of mandibles belonging to *Prionus imbricornis*, one of the largest species in the United States. The remainder of the beetle food is made up of various families, of which the May beetles (Scarabæidæ) are the most prominent. They amount to 6.31 per cent and are mostly flower-beetles (*Euphoria*) or closely allied genera. A preference for large beetles is a pronounced characteristic of this woodpecker. Weevils were found in 99 stomachs and as many as 12 were counted in one. Such harmful species as *Epicærus imbricatus*, *Phytonomus punctatus*, and *Sphenophorus zæ* were identified in several stomachs. The beetles eaten by the redhead are mostly adults, and such species as creep over the bark of trees or on bare fences or telegraph poles, where the bird loves to forage. Unlike the hairy, downy, and three-toed woodpeckers, the redhead eats very few beetle larvæ or other grubs, or ants that live in wood or other places of concealment. Apparently it is not so fond of pecking wood as are the other species, but on the other hand it has been known to peck holes in telegraph and telephone poles

until they were so weakened as to break down, thereby causing "considerable damage."<sup>1</sup>

Ants amount to 5.17 per cent of the food of the redhead, which is the lowest record but one of all the woodpeckers. The greatest number are eaten in June and July, when they aggregate a little more than 14 per cent in each month. As they are mostly taken in the warmer months, it is almost certain that they are captured in the open, not dug out of decaying trees or logs. Hymenoptera other than ants amount to 1.63 per cent. These are of course bees and wasps, and, as this bird is quite skillful in catching insects upon the wing, probably it takes most of them in the air.<sup>2</sup> In one stomach was found one worker honey bee. Parasitic species were identified in a few stomachs. Like the ants, most of the wasps were taken in midsummer.

Hemiptera, or bugs, are a small but rather regular constituent of the food. They aggregate only 1.89 per cent of the yearly diet, but include some interesting species. A collection of 6 stomachs was received from Ames, Iowa, at a time when a brood of 17-year locusts (*Tibicen septendecim*) was out. These insects had been eaten by every one of the birds, and they averaged 52 per cent of the stomachs' contents. Field observation, as well as stomach examination, shows that cicadas are eaten in their season by all kinds of insectivorous birds big enough to manage such large insects. Cicadas were found in 10 stomachs, but not all were identified as the 17-year species. Scales (Coccidæ), or bark lice, were found in 17 stomachs, and in 5 they were identified as the plum or cherry scale (*Eulecanium cerasifex*). In 1 stomach this species amounted to 60 per cent of the contents. This shows that the bird forages to some extent among the smaller branches and twigs of live trees. A few individuals of several other families of bugs were found, of which Pentatomidæ, or stinkbugs, were the favorites.

Orthoptera, in the shape of grasshoppers, crickets, and cockroaches and their eggs, were eaten very sparingly throughout the year; but in August, the grasshopper month, the redhead takes to the ground, where it feeds quite freely upon these insects. They aggregate 21.17 per cent of its diet in August, and in September 9.53 per cent, amounting in the two months to two-thirds of the grasshoppers taken in the year. The average for the year is 3.58 per cent. There is much testimony that many grasshoppers are stored up for future use. They do not, however, constitute a very large element of the food after September. The redhead may share the instinct

<sup>1</sup> Buchler, M. H., Pennsylvania Telephone Co., in letter to Biological Survey, dated Harrisburg, Pa., March 19, 1895.

<sup>2</sup> See Merriam, Bull. Nuttall Ornith. Club, III, 126, July, 1878; also Forest and Stream, IX, 451, January 17, 1878.

of its California cousin and store up much food that it never eats, thus contributing to the welfare of pilferers of the food.

Lepidoptera, that is, caterpillars, are apparently not a favorite food of the redhead. A few were eaten in the months from April to October, inclusive, but in May only do they reach 10 per cent of the food. The average for the year is 1.63 per cent. One harmful species, the wheat-head army worm (*Heliophila albilinea*), was identified in one stomach, which contained about a dozen specimens. Dragonflies, spiders, and millepeds, bits of a crayfish, eggshells, and a few bits of bone and hair of some small rodent, altogether make up the remaining 1 per cent.

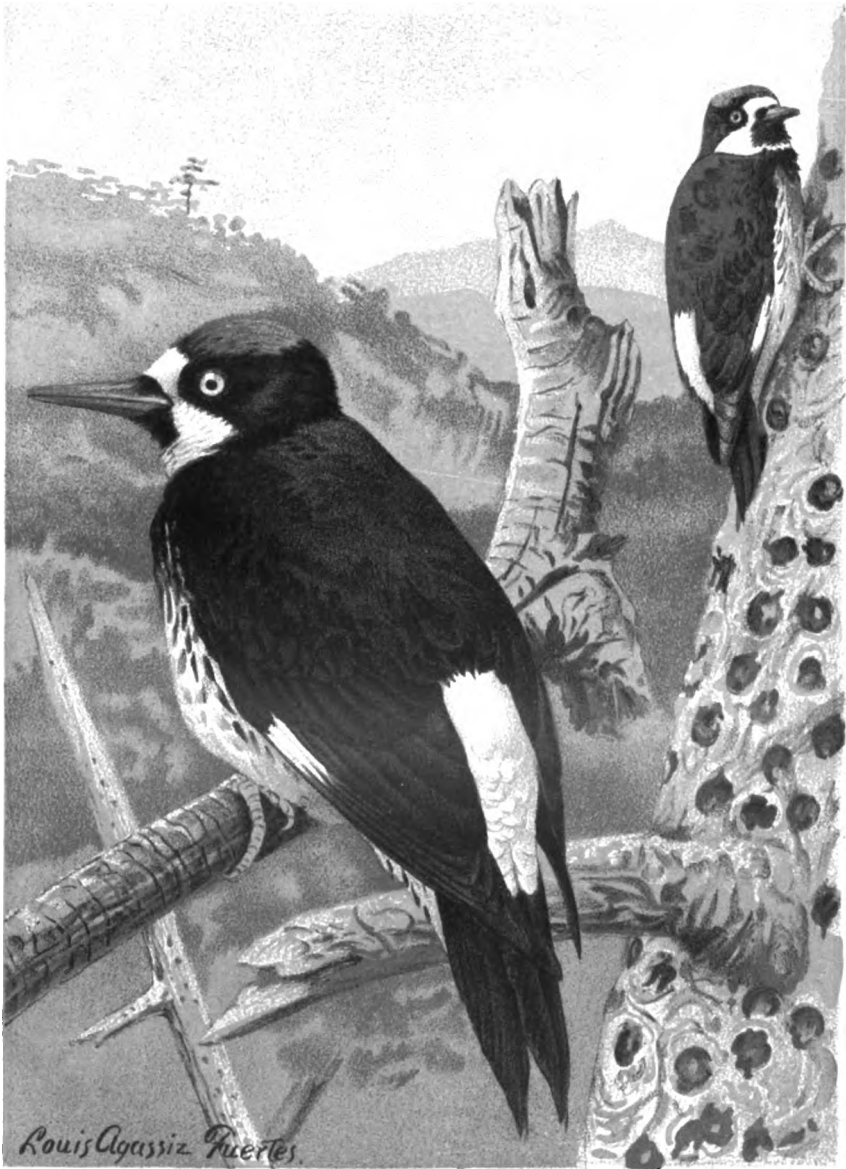
The following insects were identified in the stomachs of the redhead:

## COLEOPTERA.

<i>Cicindela</i> sp.	<i>Aphodius inquinatus.</i>
<i>Carabus</i> sp.	<i>Aphodius</i> sp.
<i>Calosoma scrutator.</i>	<i>Bolboceras farctus.</i>
<i>Calosoma calidum.</i>	<i>Dichelonycha</i> sp.
<i>Pasimachus depressus.</i>	<i>Macroductylus subspinosus.</i>
<i>Scarites subterraneus.</i>	<i>Lachnosterna</i> sp.
<i>Pterostichus sayi.</i>	<i>Anomala</i> sp.
<i>Pterostichus</i> sp.	<i>Allorhina nitida.</i>
<i>Amara fulvipes.</i>	<i>Euphoria fulgida.</i>
<i>Galerita janus.</i>	<i>Euphoria inda.</i>
<i>Chlaenius</i> sp.	<i>Euphoria sepulchralis.</i>
<i>Geopinus incrassatus.</i>	<i>Prionus imbricornis.</i>
<i>Agonoderus pallipes.</i>	<i>Elaphidion</i> sp.
<i>Anisodactylus discoideus.</i>	<i>Nodonota tristis.</i>
<i>Anisodactylus nigrita.</i>	<i>Gastroidea cyanea.</i>
<i>Anisodactylus</i> sp.	<i>Melasoma scripta.</i>
<i>Tropisternus</i> sp.	<i>Diabrotica 12-punctata.</i>
<i>Sphaeridium scarabaeoides.</i>	<i>Elcodes tricolorata.</i>
<i>Necrophorus</i> sp.	<i>Meracantha contracta.</i>
<i>Creophilus villosus.</i>	<i>Corymbites cylindricollis.</i>
<i>Staphylinus vulpinus.</i>	<i>Dicercia obscura.</i>
<i>Staphylinus maculosus.</i>	<i>Dicercia</i> sp.
<i>Coccinella 9-notata.</i>	<i>Chrysobothris</i> sp.
<i>Ips fasciatus.</i>	<i>Ptinus dubius.</i>
<i>Melanotus fissilis.</i>	<i>Ceruchus piccus.</i>
<i>Passalus cornutus.</i>	<i>Epicaula</i> sp.
<i>Phanaeus carnifex.</i>	<i>Epicurus imbricatus.</i>
<i>Canthon lavis.</i>	<i>Sitona</i> sp.
<i>Canthon</i> sp.	<i>Phytonomus punctatus.</i>
<i>Onthophagus</i> sp.	<i>Hylobius palis.</i>
<i>Atanius cognatus.</i>	<i>Balaninus</i> sp.
<i>Aphodius fossor.</i>	<i>Sphenophorus zca.</i>
<i>Aphodius fimetarius.</i>	<i>Sphenophorus</i> sp.
<i>Aphodius ruricola</i>	

## HYMENOPTERA.

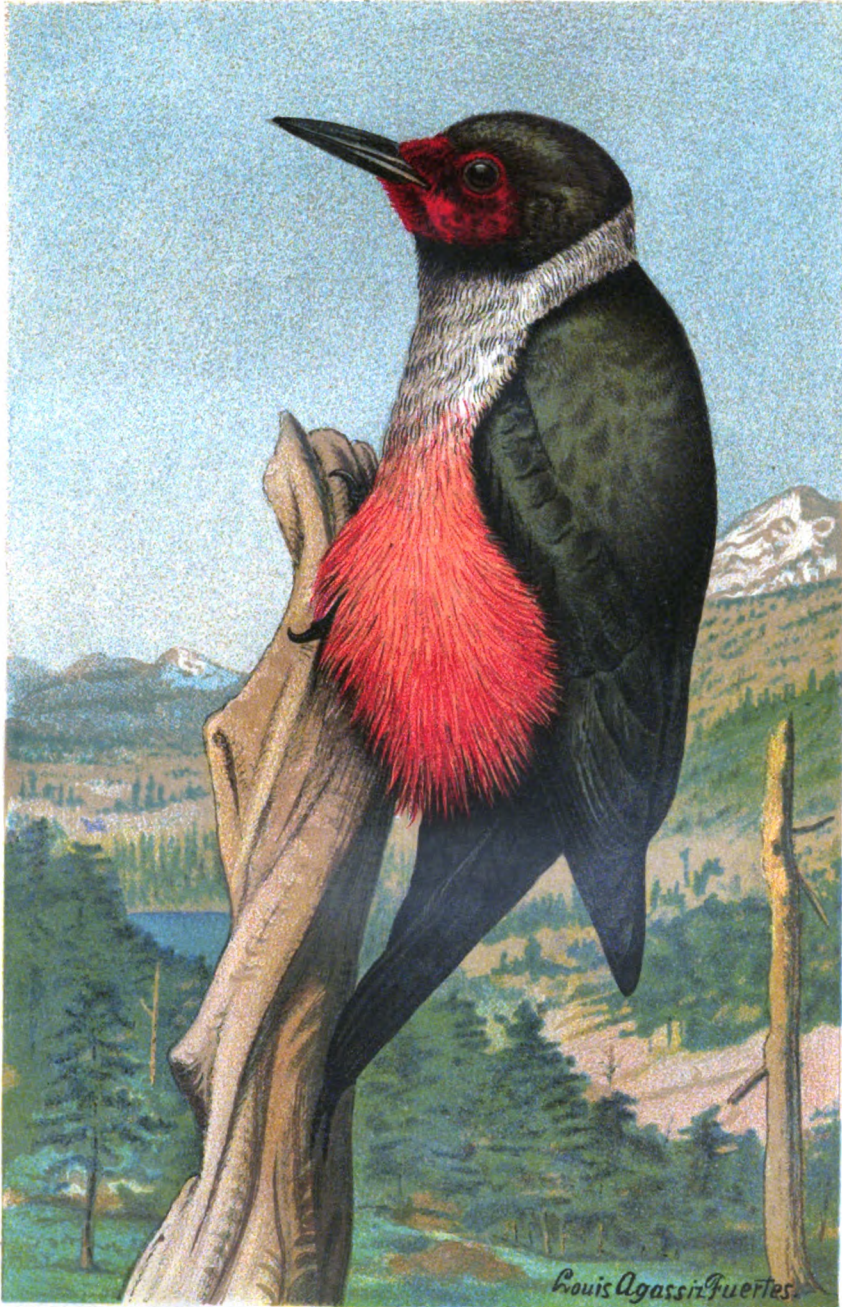
<i>Apis mellifera.</i>	<i>Ophion</i> sp.
<i>Vespa maculata.</i>	<i>Camponotus</i> sp.



WOODPECKER BY AGASSIZ; OIL BY FUERTES

CALIFORNIA WOODPECKER.





BREUKER & KESSLER CO LITH PHILA.

LEWIS WOODPECKER.



## HEMIPTERA.

*Nezara hilaris.*  
*Sinea diadema.*  
*Tibicen septendecim.*

*Tibicen* sp.  
*Eulecanium cerasifer.*

## LEPIDOPTERA.

Wheat-head army worm (*Heliophila albilinea*).

*Vegetable food.*—Some grain is eaten by the redhead from May to September. In August and September it amounts to 21.73 and 19.67 per cent, respectively. The average for the year is 4.25 per cent. Corn was identified in 64 stomachs and oats in 2. The former was in most cases immature or in the milk, and was more or less mixed with corn silk. Domestic fruit was found in 175 stomachs—that is, if the seeds of blackberries and raspberries and the pulp without seeds were all of domesticated varieties. Blackberries and raspberries were identified in 42 stomachs, domestic cherries in 15, strawberries in 7, and apples in 9. Cultivated fruit was all taken in the months from April to September, inclusive, with the maximum of 16.76 per cent in July. The average for the year is 3.30 per cent. The above account undoubtedly does the bird great injustice, as probably most of the *Rubus* fruit (blackberries and raspberries) was obtained from wayside thickets, and it is almost certain that much of the unidentified pulp contained in 102 stomachs was from wild species. The strawberries also were as likely to be wild as cultivated. Wild fruits were found in 100 stomachs, and 17 species were identified. They were eaten in every month, the most in the colder ones. February appears to be the month of maximum consumption with 50 per cent, but the record is based on only 9 stomachs. The average for the year is 16.90 per cent. Anthers of flowers should perhaps be included in this item. They were found in 4 stomachs.

Mast is evidently a favorite food of the redhead. It appears in the stomachs of every month except March, but as only 3 were taken then the exception is probably accidental. The most was eaten in the four months from October to January, inclusive, and the average for those months is 55.22 per cent, and for the year 23.26 per cent. The great bulk of this is acorns, but some other nuts and large seeds are included. This record for mast eating is, as far as known, exceeded by only a few birds, notably the California woodpecker and the jays.

Miscellaneous vegetable matter amounts to 18.30 per cent. This is made up of cambium, found in 5 stomachs, poison-ivy seeds in 7, several other *Rhus* seeds, and a number of weed seeds. The great bulk of this item, however, is a mass of hard woody granules of very irregular shape and undetermined origin. They were found

in 90 stomachs, and one contained nothing else. They have a resemblance to the woody granules in pear pulp, but are larger and more irregular. It is possible that they are derived from the pulp of some wild fruit. If so, their percentage should be added to the fruit pulp. They have been found in the food of other woodpeckers, but in comparatively small quantities.

The following fruits and seeds were identified:

Bristly greenbrier ( <i>Smilax bona-nox</i> ).	Frost grape ( <i>Vitis cordifolia</i> ).
Mulberry ( <i>Morus rubra</i> ).	Woodbine ( <i>Parthenocissus quinquefolia</i> ).
Dock ( <i>Rumex</i> sp.).	Flowering dogwood ( <i>Cornus florida</i> ).
Lambs quarters ( <i>Chenopodium album</i> ).	Rough-leaved dogwood ( <i>Cornus asperifolia</i> ).
Shadbush or service berry ( <i>Amelanchier canadensis</i> ).	Panicled dogwood ( <i>Cornus candidissima</i> ).
Bird cherry ( <i>Prunus pennsylvanica</i> ).	Sour gum ( <i>Nyssa sylvatica</i> ).
Chokecherry ( <i>Prunus virginiana</i> ).	Huckleberry ( <i>Gaylussacia</i> sp.).
Black cherry ( <i>Prunus serotina</i> ).	Black nightshads ( <i>Solanum nigrum</i> ).
Dwarf sumac ( <i>Rhus copallina</i> ).	Black elderberry ( <i>Sambucus canadensis</i> ).
Smooth sumac ( <i>Rhus glabra</i> ).	Red elderberry ( <i>Sambucus pubens</i> ).
Poison ivy ( <i>Rhus radicans</i> ).	Ragweed ( <i>Ambrosia</i> sp.).
Fox grape ( <i>Vitis vulpina</i> ).	

*Summary.*—No species of woodpecker in this country, with the possible exception of the yellow-bellied sapsucker (*Sphyrapicus varius*), has been the subject of so much adverse criticism as the red-head. It has been accused of eating nearly every variety of cultivated fruit from strawberries to oranges, of pecking corn from the ear, of eating the eggs of poultry and pigeons, of pecking open the skulls and devouring the brains of young poultry, and of destroying the eggs or young of eaves swallows and other birds. These accusations are well grounded, but the habits are probably only local. These reports have been received from hundreds of localities, but in thousands of other places where the bird abounds no such acts have been observed. Stomach examination confirms to some extent the corn-eating habit, and to a less degree the fruit-eating, but fails entirely to show that the bird habitually eats young birds or eggs.<sup>1</sup> Where this bird has done appreciable harm, it has probably been due to new and unusual conditions likely to be temporary. In its animal food the redhead does a little harm theoretically by its destruction of predatory beetles, but the harmful species eaten are enough to balance this. On the whole, there seems to be no reason to condemn this woodpecker except under very unusual conditions, and the man who claims to have killed 527 of them in four years did himself and neighbors a very doubtful service.

<sup>1</sup> Eggshells have been found in some stomachs of nearly every species of bird yet examined by the writer. They are undoubtedly, in most cases, old shells eaten for the lime.

**CALIFORNIA WOODPECKER.***(Melanerpes formicivorus bairdi.)*

The California woodpecker (Pl. IV) is distributed throughout most of the oak-covered mountain and foothill region of California, northern Lower California, and southern Oregon. It lives generally wherever large oaks are abundant, and from these it gets much of its living. Wherever it occurs it is commonly abundant, and its strongly contrasted colors and loud cries attract much attention as it flies from tree to tree. A peculiar habit has drawn much notice from non-scientific observers—that of drilling holes in tree trunks or large branches, in each of which it places an acorn. Where this bird is abundant all dead trunks or branches of any size, and many live ones, are punctured with these holes, frequently less than an inch apart. So zealous is the bird in this work that often when trees in the proper condition for puncturing are not numerous enough, it attacks buildings and drills holes in the cornices of houses or in the spires of churches; also it bores into telephone and telegraph poles and fence posts, and sometimes uses natural cavities. But the woodpecker does not get the benefit of all the acorns it lays up, for the jays have learned where they can easily obtain food in winter, and are not backward about robbing the woodpecker's larder, thus causing endless quarrels. Probably rats, mice, and squirrels also help themselves to these supplies.

For the laboratory investigation of the food of the California woodpecker 84 stomachs were available. They were taken in every month except February, April, and May—the larger numbers in June and July, when the chances for the bird to do mischief are greatest. The food was found to consist of 22.59 per cent of animal matter to 77.41 per cent of vegetable. This is the highest percentage of vegetable matter yet found in the stomach of any woodpecker, though the red-bellied (*Centurus carolinus*) comes very close to it. Most other woodpeckers eat more animal than vegetable food.

*Animal food.*—Beetles constitute the smallest item in the animal food. They amount to less than 3 per cent, and are distributed among several families, with no preference shown for any one. In July, the only month in which they are at all prominent, they reach 14.76 per cent. No wood-boring larvæ were found. This seems to indicate that this bird uses its wood-pecking powers, not to find insects, but only to make places for storing food. Ants amount to 8.09 per cent of the food. In one stomach taken in March they constitute 50 per cent of the contents, but in no other do they reach 11 per cent. The specific name of this bird, *formicivorus*, is not well chosen, for it eats fewer ants than most other species of woodpeckers. Other Hymenoptera amount to 7.34 per cent. More than half of these

were contained in stomachs taken in August, when they aggregate 37.33 per cent. A few bugs, flies, and grasshoppers, with some fragments of caterpillars, make up the remainder of the animal food—4.49 per cent. One stomach contained a few black olive scales.

*Vegetable food.*—Grain, fruit, and mast are the three items that form nearly all the vegetable food. One stomach taken in January contained nothing but corn, and in another collected in December were a few corn hulls. This is the whole of the grain record, and is of no economic interest. The average for the year but slightly exceeds 1 per cent. Fruit amounts to a little less than 23 per cent, and was found in nearly every month in which stomachs were taken. Most of it was evidently the pulp of the larger cultivated varieties, though that found in stomachs collected in the winter months could have no economic value. Seeds of the elderberry (*Sambucus*) were found in two stomachs and were the only fruit positively identified. The largest amounts were eaten in August and September, when they reached 59.34 and 54 per cent, respectively. While this is rather a high percentage of fruit eaten, complaints against the bird are not general, and the damage done to fruit over most of its range is probably comparatively small.

The principal item of the food of the California woodpecker is acorns. This amounts to 53.30 per cent of the food of the year, and was found in 58 stomachs, or 69 per cent of the whole, and 23 contained nothing else. It was eaten in every month when stomachs were taken except August, but as only 3 were collected in that month the record is not reliable. In November, when 12 stomachs were taken, acorns amounted to 93.58 per cent of the average contents. In June, when fruit and insects are abundant, it averaged in 12 stomachs 79.25 per cent. In July the least was eaten—29.47 per cent. This was made up by the animal food, which attained the highest percentage in that month. The question has been raised whether the bird stores the acorn for the sake of its meat or for the grubs which may frequently develop therein. The examination of the stomach contents removes all doubt, for while acorns are eaten freely larvæ are almost entirely wanting.

In certain localities where almonds are largely cultivated and this bird is abundant it exhibits a strong liking for these nuts. Under these conditions it is sometimes necessary to shoot every woodpecker that appears in the orchard in order to save even a reasonable part of the crop. Such conditions are likely to occur wherever large groves of oaks occur in close proximity to the orchards and this bird is correspondingly numerous. While the necessity for applying so drastic a remedy is unfortunate, it can be said that it is not so deplorable as it would be in the case of some other more conspicuously useful species.

*Summary.*—The foregoing discussion shows that the food of the California woodpecker is not of much economic importance. On the other hand, the bird can not be charged with destroying useful insects or many products of husbandry. While it eats considerable fruit, especially almonds, in fact twice as much as the linnet, it does not habitually infest orchards, and in most localities is not numerous enough to be a serious nuisance. The few insects which it takes are nearly all of harmful species, while the acorns which make up the bulk of its diet may be considered of little value. The trees used for storehouses are usually either dead or partly so, and when alive are little harmed by the punctures, which do not usually go through the bark. When, however, holes are made in buildings, telegraph or telephone poles, or fences, they are a real injury, and it is fortunate that such cases are local and exceptional. From the esthetic point of view, however, a strong plea for the bird's protection may be made. It is an interesting and picturesque species, and where it does not make itself conspicuous by reason of the damage it does it may well be allowed to live.<sup>1</sup>

#### LEWIS WOODPECKER.

(*Asyndesmus lewisi*.)

The Lewis woodpecker (Pl. V) is irregularly distributed over that part of the United States west of the eastern slope of the Rocky Mountains, north to southwestern Canada, and south to northern Mexico. In many localities within its range it is rare or absent, while very abundant in others. It is by nature somewhat shy, not greatly addicted to visiting orchards and cultivated areas.

In Oregon and Washington complaint has been made that the bird does some damage to apples. Only twice was the writer able to find cases of serious damage. An orchard situated close to a river, on the far side of which was a large area of wild land, was so persistently visited by Lewis woodpeckers, when the early apples were ripening, that the pickers were obliged to shoot the birds. One evening a number of boxes filled ready for market were left in the orchard. In the morning it was found that the woodpeckers had pulled out the papers and pecked the fruit so that it was necessary to open and repack several boxes. In the other case the orchard was in the foothills and almost completely surrounded by evergreen forests, from which the birds came and to which they retreated when alarmed.

Dr. Merriam, speaking of Fall River Valley, California, says of this bird: "Common everywhere and eating apples in several of the orchards." Also at Fort Jones: "Evidently eating apples."

<sup>1</sup> Besides the California form, *bairdi*, treated of in these pages, there is at least one other, *aculeata*, within the limits of the United States. Its range is in the southern Rocky Mountains from central western Texas to northern Arizona. No stomachs of this subspecies have been received, but probably its food habits do not differ from those of the other form.

Messrs. Grant and Ferry, writing from Klamath Hot Springs, Oregon, say: "Abundant in flocks first part of September. Persons with guns stationed in orchards \* \* \* to destroy these birds, kill 25 to 50 of them per day for from one to two weeks."

Mr. J. E. McLellam says they "never come in great numbers unless there is a good crop of mast, when they come in swarms. They hoard similar to the California woodpecker." Quite a number of apple growers interviewed by the writer testified that the bird destroyed some apples, but none of them considered the loss of any importance. As the orchards increase in area, the damage will probably become less.

Mr. W. Otto Emerson, of Haywards, Cal., in a letter to the Biological Survey, dated March 14, 1909, says of this bird:

Several cases have come under my observation when in the fall months of September and October the California and Lewis woodpeckers have made their appearance in canyon apple orchards and went into them picking open the apples for the codling moth worms they contained, going all over the trees and taking such fruit as had a wormhole in it. In one orchard of about 2 acres in extent at Sunol, this county (Alameda), near the Niles Canyon, I counted 23 bodies of the Lewis woodpeckers and 9 of the California tied up to the limbs by the legs to frighten off the birds. The owner did not seem to know what the woodpeckers were after \* \* \* till I called his attention to the condition of his wormy fruit.

For investigation of this bird's food only 59 stomachs were available. They were collected in five States from Montana and Wyoming westward to the Pacific coast. They are so irregularly distributed over the year as to make systematic study of the food impossible, but we may learn some of the elements which compose it. Animal matter amounts to 37.48 per cent and vegetable to 62.50 per cent.

*Animal food.*—Predaceous beetles were eaten to the extent of 6.72 per cent, and, as is usually the case, the most appear to have been taken in spring and early summer. They were made up of Carabidæ and Coccinellidæ (ladybird beetles). Of the former, the genus *Pasimachus* was recognized, and of the latter, two species, *Hippodamia convergens* and *H. 15-maculata*, were identified. Other beetles amount to 2.40 per cent and were all eaten in the five months from June to October. Among them were several Meloidæ, or blister beetles, not usually supposed to be very palatable. One specimen of a water beetle (*Philhydrus diffusus*) was also identified.

There is nothing in the stomachs to indicate that this bird ever digs into wood, decayed or otherwise, in search of beetle larvæ. Ants were eaten most in summer and in April, and June appears to be the month of maximum consumption, while May shows none. The average for the year is 11.87 per cent, but this can not be considered final. Other Hymenoptera reach 11.57 per cent. Hemiptera, or bugs, seem to be taken very sparingly, and those chosen were of the larger species. They amount to 1.36 per cent. Grasshoppers are

eaten—not many in August, more in July, and most in September, with a trace in October, while the eastern birds eat the most of these insects in August. The average for the year is 3.20 per cent. No caterpillars or Lepidoptera in any form were found in this bird's stomach. A few spiders amount to less than half of 1 per cent.

*Vegetable food.*—Corn was found in one stomach taken in August, and constituted 62 per cent of its contents, but amounted to only 0.46 per cent of the food of the year. No other grain was found. Pulp and skins of fruit supposed to be of cultivated varieties were noted in March, the three summer months, and October. There is no certainty that all this was cultivated fruit, and in any event that taken in March could hardly have had any economic value. The aggregate for the year is 10.90 per cent. Wild fruit was identified in 26 stomachs, all of them taken in July, August, and September. In the former it amounted to over 63 per cent of the food, and the average for the year is 14.65 per cent. Six genera—*Amelanchier*, *Ilex*, *Crataegus*, *Cornus*, *Prunus*, and *Sambucus*—were identified. Mast, or acorns, is the largest item of food. It was found in 20 stomachs and constitutes 34.46 per cent of the diet. None was found in July, but in all the other months in which stomachs were taken it amounted to a good percentage. The one stomach taken in December contained 75 per cent of this food. Seeds of poison oak (*Rhus diversiloba*) and a weed (*Amaranthus*) make up 2.05 per cent, the remainder of the vegetable food.

*Summary.*—It is hardly possible to draw definite conclusions from so little material, especially when distributed over so large a territory. While the bird eats some useful beetles, probably it does no serious harm in this way. It is not likely to damage grain. Evidently, however, it has a pronounced taste for fruit, which at present is gratified mostly by wild species; but if the wild fruit-bearing shrubs and trees in its range should ever be replaced by cultivated varieties, it would doubtless turn to cultivated fruits. Further investigation in both field and laboratory are necessary in order to fix definitely the economic status of the Lewis woodpecker.

#### RED-BELLIED WOODPECKER.

(*Centurus carolinus*.)

The red-bellied woodpecker ranges over the eastern United States as far west as central Texas and eastern Colorado, and as far north as New York, southern Ontario, southern Michigan, and southern Minnesota. It breeds throughout this range and appears to be irregularly migratory. Very strangely, it often goes north of its breeding range to spend the winter. Four stomachs, collected in November and December, have been received from Canada, and in eight years of residence in central Iowa the writer found the species

abundant every year during the winter, but never saw one in the breeding season. It is rather more of a forest bird than some of the other woodpeckers, but is seen frequently in open or thinly timbered country. In the northern part of its range it appears to prefer deciduous growth, but in the south is quite common in pine forests.

There is some evidence that this bird is occasionally injurious to the horticulturist. Dr. B. H. Warren says:

In various sections of Florida, where the red-bellied woodpeckers are exceedingly numerous, in fact by odds the most abundant of all the woodpeckers, the common names of "orange sapsucker" and "orange borer" are universally applied to them. On making inquiry of farmers and others, I learned that the names were given because these woodpeckers "sucked the sap" of orange trees and fed on oranges. Supposing these statements were wrongfully made, I at first gave but little attention to them. When, however, I visited Welaka, Palatka, Volusia, Deland, and other places where numerous orange trees were thriving, I was informed by the orange growers that the red-bellied woodpeckers oftentimes destroyed large numbers of oranges when they had matured and were ready for picking; also, that "they damaged the orange trees by boring holes in them and sucking the sap." I had but little opportunity of making a careful study of this orange-eating habit, so greatly talked about, owing to the fact that when I first visited these localities it was late in February, or after the oranges had been picked and shipped north. In the month of March, 1885, I camped a few days at Bluffton, near Volusia, in an orange grove owned by Mr. Bird, of New York City. This grove contained about 30 acres of trees, which were loaded with fruit, then being picked for market. Through the kindness of Mr. Bird and his overseer, Mr. Curtis, I collected 26 red-bellied woodpeckers in this orange grove. Eleven of these birds had fed to a more or less extent on oranges.

Three of the 11 stomachs taken from specimens killed in the forenoon, soon after daylight, contained only orange pulp. Eight stomachs showed, in addition to orange pulp, insects and berries. The stomachs of the remaining 15 birds contained no traces of oranges, but revealed chiefly insects, a few berries, and seeds. I examined two dozen or more oranges which had been attacked by the woodpeckers, and found that all had been bored about midway between the stem and blossom end. These holes, always round, varied greatly in size. The birds usually, I think, pick off the skin from a space about the size of an ordinary 5-cent piece, and then eat out the pulp. In an orchard at Hawkinsville, near Deland Landing, on the St. Johns River, I oftentimes, in the month of April, 1885, found oranges which had been evidently overlooked when the crop was gathered, and in most instances observed that they were bored. In this orchard on one occasion I saw a red-bellied woodpecker eating an orange. He evidently recognized the fact that it was about the last of the season, as he had enlarged the opening sufficiently so that his head was almost entirely hidden in the yellow skin, from the sides of which he picked the few remaining particles of pulp. I was shown orange trees that these "sapsuckers" were said to have bored. These borings, however, did not appear to injure the trees, as they seemed to me to be equally as flourishing as other trees whose trunks showed no marks of a woodpecker's bill.

Mr. William Brewster has made some observations on this point. He says:

As corroborating Dr. Warren's account <sup>1</sup> in his late report on the birds of Pennsylvania, it may be worth while to state that when at Enterprise, Fla., in February, 1889, I observed a red-bellied woodpecker eating the pulp of a sweet orange. He flew down to the ground and, hopping along rather clumsily, approached an orange, and

<sup>1</sup> Warren, B. H., *Birds of Pennsylvania*, ed. 2, pp. 174-175, 1890.



FLICKER (ADULT MALE).



for several minutes pecked at it in a slow deliberate way. When I showed myself he at once took flight and sought shelter in the dense foliage of the trees above. Upon examining the orange I found that it was decayed through the whole of one side. In the sound portion were three holes, each nearly as large as a silver dollar, with narrow strips of peel between them. The pulp had been eaten out quite to the middle of the fruit. Small pieces of the rind were thickly strewn about the spot. Upon searching closely I discovered several other oranges that had been attacked in a similar manner. All were partially decayed and were lying on the ground. I was unable to find any on the trees which showed any marks of the woodpecker's bill. The owner of this grove was surprised when I called his attention to the above facts, which were quite new to him. Nor had any of the other orange growers in the neighborhood any knowledge of this orange-eating habit of the red-bellied woodpecker.<sup>1</sup>

Mr. Mortimer also gives testimony upon this habit of the bird:

During February and March, 1889, while gathering fruit or pruning orange trees, I frequently found oranges that had been riddled by this woodpecker and repeatedly saw the bird at work. I never observed it feeding upon fallen oranges. It helped itself freely to sound fruit that still hung on the trees, and in some instances I have found 10 or 12 oranges on one tree that had been tapped by it. Where an orange accidentally rested on a branch in such a way as to make the flower end accessible from above or from a horizontal direction the woodpecker chose that spot, as through it he could reach into all the sections of the fruit, and when this was the case there was but one hole in the orange; but usually there were many holes around it. It appeared that having once commenced on an orange the woodpecker returned to the same one repeatedly, until he had completely consumed the pulp, and then he usually attacked another very near to it. Thus I have found certain clusters in which every orange had been bored, while all the others on the tree were untouched. An old orange grower told me that the "sapsuckers," as he called them, never touch any but very ripe oranges and are troublesome only to such growers as reserve their crops for the late market. He also said that it is only within a very few years that they have shown a taste for the fruit, and I myself observed that, although red-bellies were very common in the neighborhood, only an individual, or perhaps a pair, visited any one grove. In one case a pair took up their station in a dead pine near a grove and made excursions after the fruit at all hours of the day, being easily located by the noise they kept up.<sup>2</sup>

Dr. B. H. Warren states that the stomachs of three red-bellied woodpeckers captured in winter in Chester and Delaware Counties, Pa., contained black beetles, larvæ, fragments of acorns, and a few seeds of wild grapes. The stomachs of eight adults from the St. Johns River, Florida, contained red seeds of two species of palmetto, but no insects. Two additional stomachs from the same locality contained palmetto berries, fragments of crickets (*Nemobius* and *Orocharis saltator*), a palmetto ant (*Camponotus escuriens*), and numerous joints of a myriapod, probably *Julus*.<sup>3</sup>

Dr. Townend Glover found in the stomach of a red-bellied woodpecker killed in December "pieces of acorns, seeds, and gravel, but no insects. Another, shot in December, contained wing cases of *Buprestis*,

<sup>1</sup> Brewster, William, Auk, VI, 337-338, 1889.

<sup>2</sup> Mortimer, D. Auk, VII, 339-340, 1890.

<sup>3</sup> Birds of Pennsylvania, ed. 2, pp. 174, 178, 1890.

and a species of wasp, or *Polistes*, acorns, seeds, and no bark. A third, shot in May, was filled with seeds, pieces of bark, and insects, among which was an entire *Lachnosterna*, or Maybug."<sup>1</sup>

For the investigation of the food of the red-bellied woodpecker 271 stomachs were available. They were collected in 17 States and Ontario, and represent every month in the year, though but few were taken in June and July. In the first analysis the food was found to consist of 30.94 per cent animal matter to 69.06 of vegetable. The former consists of insects and spiders, with a few tree frogs and lizards, while the latter may be considered as made up of grain, fruit, and mast.

*Animal food.*—Predatory beetles (Carabidæ) amount to 0.86 per cent, and consist of some of the larger genera like *Pasimachus* and *Calosoma*. They were probably found on the bark of trees. Other beetles, all more or less harmful, aggregate 9.32 per cent of the food. Six species of weevils or snout-beetles were identified, and 14 individuals were taken from one stomach. There were also quite a number of wood-boring larvæ, which the birds must have dug out from the wood, thus benefiting the forest. Beetles form a pretty steady article of diet, and starting with 3.62 per cent in January they increase with fair regularity to May, when they attain the maximum of 27.57 per cent, from which they slowly decrease to 1 per cent in December.

Ants are eaten to the extent of 6.45 per cent of the food and are a fairly constant article of diet. The most are eaten during the warmer months, though none were found in the two stomachs taken in June, which is probably accidental. Evidently this bird does not dig all of the ants it eats from decaying wood, like the downy woodpecker, but, like the flickers, collects them from the ground and the bark of trees. Other Hymenoptera amount to 1.45 per cent, and while these insects are known to be great lovers of warmth and sunshine, most of them are eaten in fall and spring, and many even in winter, when they are usually less numerous. Orthoptera (grasshoppers, crickets, etc.) constitute 5.83 per cent of the food. They were found in 51 stomachs—grasshoppers in 27, eggs of cockroaches in 15, crickets in 8, and a mantis (devil's rear-horse) in 1. Two stomachs contained the eggs of grasshoppers, which indicates that this bird occasionally forages on the ground. Cockroaches were represented entirely by their egg cases (ootheca). These insects extrude their eggs, not singly like most other creatures, but packed together in a case somewhat like the clip of cartridges used for some modern breech-loading rifles. These cases are probably found by birds in crevices of the bark of trees. Orthoptera are eaten throughout the

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<sup>1</sup> United States Agric. Rept. for 1865, p. 38, 1866.

year, but in quantities varying greatly from month to month. In a general way, however, more were eaten in the summer season.

Hemiptera, or bugs, amount to 1.86 per cent of the food, and form a small but fairly regular constituent of the monthly diet. Scales were found in one stomach, but most of the bugs eaten were of larger species, and the majority were Pentatomidæ or stink-bugs. Caterpillars were taken quite regularly, and average 2.88 per cent of the diet. A few of them were identified as wood-borers. Spiders and millepedes, with a few doubtful insects and small vertebrates, make up 2.29 per cent, the remainder of the animal food. Spiders were eaten at all times, but in trifling quantities. Small tree frogs were found in 9 stomachs and remains of a lizard (*Anolis carolinensis*) in 2. One stomach contained the lingual ribbon of a snail.

The following is a list of the insects identified:

#### COLLEOPTERA.

<i>Calosoma wilcoxi.</i>	<i>Lachnosterna</i> sp.
<i>Pasimachus depressus.</i>	<i>Nodonota puncticollis.</i>
<i>Pasimachus</i> sp.	<i>Hylobius pales.</i>
<i>Catogenus rufus.</i>	<i>Lixus</i> sp.
<i>Ips fasciatus.</i>	<i>Dorytomus mucidus.</i>
<i>Trogosita virescens.</i>	<i>Pseudomus truncatus.</i>
<i>Melanotus</i> sp.	<i>Cryptorhynchus obliquus.</i>
<i>Passalus cornutus.</i>	<i>Balaninus</i> sp.
<i>Dichelonycha</i> sp.	<i>Cratoparis lunatus.</i>

#### HEMIPTERA.

*Nezara hilaris.*

*Vegetable food.*—Corn was the only grain found in the food of the red-bellied woodpecker. It was contained in 39 stomachs, rather irregularly distributed through the year, but none in the three summer months, April, or November. The great bulk was eaten in the three winter months and in March and September. In September it was undoubtedly from the green ear in the field, but the rest must have been waste. The total for the year is 3.99 per cent. Fruit amounts to 27.28 per cent and forms a notable percentage of the food in every month. The month of greatest consumption is August, with 64.10 per cent, while April shows the least, 7.50 per cent. The larger part of this consists of wild fruit, of which 23 species were identified. What was thought to be apple pulp was found in one stomach, cultivated grape in one, and blackberry or raspberry in one. Fruit pulp not further identified occurred in 15 stomachs and may have been of cultivated varieties. No great preference is shown for any one species of wild berry, but mulberries, woodbine, fox grapes, and sour gum were found in the most stomachs.

Mast amounts to 30.70 per cent and is the largest item of food. Acorns, beechnuts, hazelnuts, and pecans make up most of this

item. It is eaten throughout the year except during the three summer months. It was found in 178 stomachs, and the greatest consumption appears to be in November, when it reached 67.05 per cent of the month's food, and it does not fall much below this figure until spring. This record for mast eating is the largest of that of any bird of this family except the California woodpecker. In most cases where birds eat much mast they habitually store up nuts and seeds for future use. The writer has been able to find but one reference to such a habit in this bird. W. L. Dawson, in *Birds of Ohio*, page 357, 1903, says it "lays up frugal stores of mast and corn." This seems quite probable, in view of what is found in the stomachs. Poison ivy seeds amount to 2.15 per cent and are eaten in every month from August to February, inclusive.

The following fruits and seeds were found in the stomachs:

Short-leaved pine ( <i>Pinus mitis</i> ).	Poison ivy ( <i>Rhus radicans</i> ).
Other pine seeds ( <i>Pinus</i> sp.).	American holly ( <i>Ilex opaca</i> ).
Saw palmetto ( <i>Serenoa serrulata</i> ).	Swamp holly ( <i>Ilex decidua</i> ).
Date palm ( <i>Serenoa</i> sp.).	Frost grape ( <i>Vitis cordifolia</i> ).
Greenbrier ( <i>Smilax glauca</i> ).	Fox grape ( <i>Vitis vulpina</i> ).
Bristly greenbrier ( <i>Smilax bona-nox</i> ).	Woodbine ( <i>Parthenocissus quinquefolia</i> ).
Other greenbrier ( <i>Smilax</i> sp.).	Prickly pear ( <i>Opuntia</i> sp.).
Bayberry ( <i>Myrica carolinensis</i> ).	Wild sarsaparilla ( <i>Aralia nudicaulis</i> ).
Hackberry ( <i>Celtis occidentalis</i> ).	Flowering dogwood ( <i>Cornus florida</i> ).
Red mulberry ( <i>Morus rubra</i> ).	Rough-leaved dogwood ( <i>Cornus asperifolia</i> ).
Smartweed ( <i>Polygonum</i> sp.).	Panicked dogwood ( <i>Cornus candidissima</i> ).
Pokeberry ( <i>Phytolacca decandra</i> ).	Sour gum ( <i>Nyssa sylvatica</i> ).
Sassafras ( <i>Sassafras sassafras</i> ).	Huckleberry ( <i>Vaccinium</i> sp.).
Blackberry or raspberry ( <i>Rubus</i> sp.).	Elderberry ( <i>Sambucus canadensis</i> ).
Wild black cherry ( <i>Prunus serotina</i> ).	Ragweed ( <i>Ambrosia</i> sp.).
Sumac ( <i>Rhus glabra</i> ).	

*Summary.*—Only one element in the food of the red-bellied woodpecker has much economic significance. The bird evinces a decided taste for fruit, and sometimes injures orchards, as in Florida orange groves. The contents of the stomachs, however, show that wild fruits are the favorites, and probably only when these have been replaced by cultivated ones is any mischief done. Orange pulp was not positively identified in any stomach, though quite a number were collected in Florida during the orange season. Only a little of the grain eaten is taken when it is a loss to the farmer. In its animal food the bird is almost entirely beneficial, as the insects eaten are largely noxious.

#### FLICKER.

(*Colaptes auratus* subsp.)

The flicker (Pl. VI), known also as the golden-winged woodpecker, yellow-shafted woodpecker, high-holder, yellow-hammer, pigeon woodpecker, and hairy-wicket, is one of the most widely distributed and best known species in the United States. This is one of the few

woodpeckers whose flesh is considered palatable, and a few years ago large numbers were shot for market every fall when wild black cherries were ripe. The bird is so fond of this fruit that when feeding in the trees it loses its natural shyness and is easily approached and killed. Fortunately it is now protected by law in most of the States, and it should be in all. It is a bird of the open country rather than of the forest. It is much more wary than the hairy or downy. It visits the orchard regularly, but does not make serious inroads on the fruit, and it forages much upon the ground—in fact, in spite of its liking for tall trees, the flicker is the most terrestrial of American woodpeckers.

This species is distributed over the whole of the eastern United States and north to Canada and Alaska, and is replaced in the West by the red-shafted flicker. The two forms meet on the Great Plains and along the eastern edge of the Rocky Mountain region and intermingle in all degrees of hybridism. Typical specimens of either species are frequently taken far within the range of the other, as, for instance, a perfect *Colaptes auratus* was collected by the writer a few miles east of Haywards, Cal., while typical *C. cafer collaris* can be taken every winter at Ames, Iowa. With the possible exception of the yellow-bellied woodpecker, the eastern flicker is the most migratory American species. In winter it is rarely seen in New England and only in small numbers in the other northern States. As it breeds abundantly in Canada, it becomes very numerous in the northern tier of States in fall when migrating. At this time it subsists largely upon wild cherries and other wild fruits.

The flicker rears from 6 to 10 young in each brood. The nest is built in a cavity excavated in a partially decayed tree, and is often quite elaborate, but in some cases it is in a hole caused by natural decay, where little or no preparatory work is required. The young find their voices very early in life, and by the time they are a week old make a great outcry every time they receive a visit from their parents or even hear approaching footsteps.

Complaints have been made that the flicker eats corn and cultivated fruit to an injurious extent, but the charges are not very specific, and the stomach contents do not indicate extensive depredations of this kind.

For the investigation of the food of the eastern flicker, 684 stomachs were available. They were collected in 35 States, the District of Columbia, and Canada, and are very evenly distributed through the year. The food consists of 60.92 per cent of animal matter to 39.08 of vegetable. In addition the stomachs contain considerable fine sand, which is probably not taken to aid digestion, but is swallowed accidentally with some kinds of food, notably ants. Quite a quantity of vegetable rubbish is taken in the same way.

*Animal food.*—Predaceous ground beetles (Carabidæ) form a small but very constant element of the flicker's food. Among those eaten are some of the larger and more predatory genera, such as *Calosoma*, *Scarites*, and *Pterostichus*. The total amount eaten in the year is only 1.62 per cent of the food, and in August, the month of greatest consumption, it rises to only 3.79 per cent. Other beetles are found in the food of every month, but in rather irregular amounts. The aggregate for the year is 3.52 per cent. The favorite food of the flicker, however, is ants. They form the largest item of animal food, not only in the aggregate but in every month. The total for the year is 49.75 per cent of the food. They were found in 524 of the 684 stomachs, i. e., in 76 per cent of the whole, and there were 98 stomachs that contained no other food. The following table shows the importance of ants in the diet of the flicker:

Months.	Number of stomachs.	Per cent of ants in food.	Number of stomachs with ants.	Per cent of stomachs with ants.	Number with no other food.
January.....	34	24.09	20	58.8	.....
February.....	55	29.73	31	56.3	4
March.....	37	79.14	32	86.5	14
April.....	75	80.17	70	93.3	21
May.....	33	79.24	32	96.9	9
June.....	31	79.19	30	96.8	9
July.....	51	70.74	47	92.1	13
August.....	92	61.47	84	91.3	12
September.....	138	42.61	108	76.1	12
October.....	54	21.79	31	57.4	2
November.....	41	17.37	22	53.6	1
December.....	43	11.46	17	39.5	1
Total.....	684		524		98
Average per month.....		49.75		74.9	

In one case a stomach and crop were both filled with very small ants (*Cremastogaster* sp.). The whole mass was divided with care into 16 parts as nearly equal as possible, and in one part 315 ants were counted, giving 5,040 in one meal of one flicker. In addition there were at least 100 pupæ. Two other stomachs and crops examined in the same way each gave a little over 3,000 ants. Probably each of 100 stomachs in the collection contained nearly as much ant food as these, but the number of ants was less because they were of larger species. A large proportion of the ants eaten are of species that live in the earth, and these appear to be the principal food the flicker obtains on the ground. In every case where the stomach held a quantity of these small ants, a lot of fine sand revealed their source.

Since the flicker destroys so many ants, it may be well to inquire as to the economic bearing of this work. As a rule we do not hear many serious complaints against ants. They do not attack crops or manufactured products. Probably they do some good by devouring dead matter, both animal and vegetable, and in this way hasten the decay of dead trees. On the other hand, some species enter

houses and become a positive nuisance, as, having their nest in an inaccessible place, it is almost impossible to destroy them. Other species establish colonies in lawns or gardens and are so persistent that nothing short of digging out and carrying off the whole area of earth which they have preempted will rout them from their chosen home. When timber has been injured by wood-boring beetle larvæ, ants enlarge the burrows and in a few years riddle and spoil the whole trunk. The worst sin of the ants, however, is that they protect and foster plant lice in every possible way. They defend them from their enemies, cover them with sheds to shield them from inclement weather, and upon the approach of winter they carry some species into the ground and place them on the roots of plants for the winter and at the return of warm weather bring them to the upper air and place them in a position suitable to their needs. As plant lice constitute one of the worst pests to horticulture, their protectors are a nuisance and should be destroyed. As we have seen, flickers devour enormous numbers of them and aid essentially in holding them in check. Hymenoptera other than ants amount to only four one-hundredths of 1 per cent of the yearly food.

Bugs (Hemiptera) are eaten in nearly every month, but only in small quantities. In January, February, and May they reach an average of about 3 per cent, but in no other month do they amount to even 1 per cent. One stomach contained scales not further identified, another held 17 chinch bugs (*Blissus leucopterus*), and in another were what were probably the same in an early stage of growth. Two stomachs contained each a single bedbug (*Cimex lectularius*), probably taken on trial and not relished. Cicadas, or harvest flies (*Tibicen rimosa*), were found in several stomachs. The aggregate of Hemiptera for the year is only 0.85 per cent.

Orthoptera, in the shape of grasshoppers, crickets, and cockroaches, amount to 2.39 per cent. They are eaten in every month, but not very regularly. Singularly, the maximum quantity was taken in January, 9.77 per cent, which is more than twice the amount in any other month. This record, however, was made by birds taken in Texas, which had partaken freely of crickets. The least consumption occurs in August, the grasshopper month, which shows that the flicker is not a lover of grasshoppers.

Lepidoptera, in the form of caterpillars, are eaten very sparingly—in fact in only three months do they amount to as much as 1 per cent. In August they reach 4.91 per cent, 3.13 in June, and 3.29 in November. The only one identified was the common zebra caterpillar of the gardens (*Mamestra picta*). The total for the year is 1.28 per cent. A few fly larvæ, spiders, myriapods, crustaceans, and snails make up the rest of the animal food. Larvæ of Tipulidæ (crane flies) were found in 3 stomachs and *Bibio* larvæ (March flies) in 2. As

these creatures breed in the earth, this again shows the terrestrial habits of the flicker. Spiders and myriapods were found in a good many stomachs, but few were taken at one time, so the aggregate is not large. Crustaceans, in the form of *Oniscus* (sowbugs), were found in 5 stomachs. Snail shells, mostly fragments, were of frequent occurrence, and one was identified as *Zonitoides minusculus*. The total of these miscellaneous creatures is 1.49 per cent, which completes the record of animal food.

The following is a list of the insects identified in the stomachs:

#### COLEOPTERA.

<i>Cicindela vulgaris.</i>	<i>Quedius prostrans.</i>
<i>Calosoma calidum.</i>	<i>Stelidota 8-maculata.</i>
<i>Elaphrus oblitteratus.</i>	<i>Melanotus communis.</i>
<i>Scarites subterraneus.</i>	<i>Copris minutus.</i>
<i>Pterostichus sayi.</i>	<i>Onthophagus hecate.</i>
<i>Amara exarata.</i>	<i>Onthophagus sp.</i>
<i>Amara impuncticollis.</i>	<i>Aphodius fimetarius.</i>
<i>Amara angulata.</i>	<i>Aphodius inguinatus.</i>
<i>Calathus ingratus.</i>	<i>Aphodius bicolor.</i>
<i>Platynus placidus.</i>	<i>Aphodius sp.</i>
<i>Platynus punctiformis.</i>	<i>Lachnosterna sp.</i>
<i>Brachynus puberulus.</i>	<i>Ligyris sp.</i>
<i>Chlœnius sp.</i>	<i>Caryoborus arthriticus.</i>
<i>Agonoderus pallipes.</i>	<i>Opatrinus aciculatus.</i>
<i>Harpalus faunus.</i>	<i>Blapstinus pruinosis.</i>
<i>Harpalus pennsylvanicus.</i>	<i>Blapstinus pulverulentus.</i>
<i>Harpalus pleuriticus.</i>	<i>Blapstinus sp.</i>
<i>Harpalus ellipsis.</i>	<i>Tanymericus confertus.</i>
<i>Anisodactylus rusticus.</i>	<i>Sitones hispidulus.</i>
<i>Anisodactylus sp.</i>	<i>Phytonomus punctatus.</i>
<i>Stenus shoshonis.</i>	<i>Sphenophorus sp.</i>

#### HYMENOPTERA (ANTS).

<i>Formica obscuripes.</i>	<i>Camponotus minutus.</i>
<i>Formica nitidiventris.</i>	<i>Camponotus pictus.</i>
<i>Formica subsericea.</i>	<i>Camponotus sp.</i>
<i>Formica subpolita.</i>	<i>Myrmica scabrinodis.</i>
<i>Formica gagates.</i>	<i>Myrmica sabuleti.</i>
<i>Formica subænescens.</i>	<i>Myrmica sp.</i>
<i>Formica sp.</i>	<i>Cremastogaster læviuscula.</i>
<i>Lasius claviger.</i>	<i>Cremastogaster minutissimus.</i>
<i>Lasius aphidicola.</i>	<i>Cremastogaster sp.</i>
<i>Lasius brevicornis.</i>	<i>Aphænogaster picea.</i>
<i>Lasius americanus.</i>	<i>Aphænogaster fulvum.</i>
<i>Lasius alienus.</i>	<i>Aphænogaster treatæ.</i>
<i>Lasius miniatus.</i>	<i>Aphænogaster sp.</i>
<i>Lasius subniger.</i>	<i>Prenolepis imparis.</i>
<i>Lasius sp.</i>	<i>Pheidole sp.</i>
<i>Camponotus marginatus.</i>	<i>Solenopsis geminata.</i>
<i>Camponotus melleus.</i>	<i>Solenopsis debilis.</i>
<i>Camponotus pennsylvanicus.</i>	<i>Tetramorium sp.</i>

## HEMIPTERA.

*Zelus renardi.*  
*Blissus leucopterus.*  
*Metapodius sp.*

*Tibicen rimosa.*  
*Cimex lectularius.*

## DIPTERA.

*Bibio sp.*

*Tipula sp.*

## LEPIDOPTERA.

*Mamestra picta.*

## ORTHOPTERA.

*Gryllus sp.*

*Ischnoptera sp.*

## ISOPTERA.

*Termes flavipes.*

## CRUSTACEA.

*Oniscus sp.*

## MOLLUSCA.

*Parastarte triquetra.*

*Zonitoides minusculus.*

*Vegetable food.*—Corn was found in 17 stomachs of the flicker, wheat in one, and buckwheat in two. One stomach taken in March was entirely filled with corn, evidently waste grain. Most of the remainder was taken in fall and early winter. The total for the year is 1.12 per cent. Small fruits are the favorite vegetable food with this bird. They are eaten in every month and constitute a good percentage in all but two. In April and May fruit amounts to less than 1 per cent, but increases through the summer to October, when it is about 42 per cent of the food, and then decreases gradually to the minimum in April. Possibly some of the *Rubus* fruits were cultivated, and the cherries in one stomach certainly were, while the fruit pulp in 21 stomachs may have been, but in any case the amount is insignificant and shows that the flicker eats but little domestic fruit. On the other hand, 31 species of wild fruits were identified. They were contained in 265 stomachs, and 40 contained no other food. They are not only the favorite vegetable food, but, next to ants, are the favorite food of the year. There is also shown a fondness for the seeds of various species of poisonous *Rhus* (poison ivy, poison oak, and poison sumac). These seeds are eaten mostly in the fall and winter months, when small fruits are less abundant. May, June, and July are the only months when none were eaten. November appears to be the month of greatest consumption, when they reach nearly 38 per cent. The aggregate for the year is 9.25 per cent.

Mast, if the term be limited to acorns and other nuts, is not a favorite food of the flicker. It is eaten to some extent in the three

winter months and occasionally tasted at other times. It amounts to 1.79 per cent of the food. Cambium, weed seed, nonpoisonous *Rhus* seeds, and rubbish are found in some stomachs pretty regularly through the year, though the quantity is very irregular. It would appear that the three former are eaten only in default of anything better, and the last is probably taken accidentally when seeking ants in rotten wood or under rubbish. The total amount is 6.64 per cent and completes the quota of vegetable food.

The following fruits and seeds were identified:

	Number of stomachs containing		Number of stomachs containing
Hemlock (foliage) ( <i>Tsuga canadensis</i> ).....	1	White clover ( <i>Trifolium repens</i> ).....	6
Red cedar ( <i>Juniperus virginiana</i> ).....	5	Crane's-bill ( <i>Geranium</i> sp.).....	1
Barnyard grass ( <i>Panicum</i> sp.).....	1	Croton ( <i>Croton</i> sp.).....	1
Foxtail grass ( <i>Ixophorus</i> sp.).....	2	Dwarf sumac ( <i>Rhus copallina</i> ).....	3
Glaucous-leaved greenbrier ( <i>Smilax glauca</i> ).....	1	Smooth sumac ( <i>Rhus glabra</i> ).....	11
Cat brier ( <i>Smilax rotundifolia</i> ).....	1	Poison sumac ( <i>Rhus vernix</i> ).....	5
Bristly greenbrier ( <i>Smilax bona-nox</i> ).....	1	Poison ivy ( <i>Rhus radicans</i> ).....	82
Laurel-leaved brier ( <i>Smilax laurifolia</i> ).....	3	Poison oak ( <i>Rhus diversiloba</i> ).....	1
Bayberry ( <i>Myrica carolinensis</i> ).....	48	Sumac ( <i>Rhus</i> sp.).....	11
Sweet fern ( <i>Comptonia peregrina</i> ).....	1	American holly ( <i>Ilex opaca</i> ).....	1
Beech ( <i>Fagus americana</i> ).....	1	Dahoon holly ( <i>Ilex cassine</i> ).....	1
Hackberry ( <i>Celtis occidentalis</i> ).....	24	Ink berry ( <i>Ilex glabra</i> ).....	8
Mulberry ( <i>Morus rubra</i> ).....	2	Swamp holly ( <i>Ilex decidua</i> ).....	1
Pale persicaria ( <i>Polygonum lapathifolium</i> ).....	1	Black alder ( <i>Ilex verticillata</i> ).....	4
Lady's thumb ( <i>Polygonum persicaria</i> ).....	1	Burning bush ( <i>Euonymus</i> sp.).....	1
Black bindweed ( <i>Polygonum convolvulus</i> ).....	1	Frost grape ( <i>Vitis cordifolia</i> ).....	22
Smartweed ( <i>Polygonum</i> sp.).....	4	Flowering dogwood ( <i>Cornus florida</i> ).....	16
Pokeweed ( <i>Phytolacca decandra</i> ).....	5	Rough-leaved dogwood ( <i>Cornus asperifolia</i> ).....	1
Magnolia ( <i>Magnolia foetida</i> ).....	3	Alternate-leaved dogwood ( <i>Cornus alternifolia</i> ).....	1
Spicebush ( <i>Benzoin benzoin</i> ).....	2	Sour gum ( <i>Nyssa sylvatica</i> ).....	32
Sand blackberry ( <i>Rubus cuneifolius</i> ).....	1	Large tupelo ( <i>Nyssa aquatica</i> ).....	2
Blackberry or raspberry ( <i>Rubus</i> sp.).....	15	Huckleberry ( <i>Gaylussacia</i> sp.).....	6
Juneberry ( <i>Amelanchier canadensis</i> ).....	3	Blueberry ( <i>Vaccinium</i> sp.).....	7
Wild black cherry ( <i>Prunus scrotina</i> ).....	30	Black nightshade ( <i>Solanum nigrum</i> ).....	1
Chokecherry ( <i>Prunus virginiana</i> ).....	7	Mullein ( <i>Verbascum thapsus</i> ).....	1
Crab cherry ( <i>Prunus avium</i> ).....	1	Black elderberry ( <i>Sambucus canadensis</i> ).....	11
		Red elderberry ( <i>Sambucus pubens</i> ).....	1
		Ragweed ( <i>Ambrosia artemisiifolia</i> ).....	3

*Summary.*—From the point of view of the food analyst the farmer and horticulturist have very little quarrel with the flicker. It eats only a few predaceous ground beetles. The remainder of the animal food is entirely of harmful species. In its vegetable diet, grain and fruit are the only useful products eaten, and the quantities are insignificant. The bird, like many others, has the bad habit of sowing broadcast the seeds of the poison *Rhus*, but there seems no remedy for this.

## RED-SHAFTED FLICKER.

(*Colaptes cafer collaris* and other subsp.)

The red-shafted flicker inhabits that part of North America westward from the Great Plains, where its range meets that of the golden-winged woodpecker. Typical specimens of *Colaptes cafer collaris* are found as far east as South Dakota, central Iowa, and central Texas. The writer took them in winter at Ames, Iowa, for several years in succession. The eastern and western forms of the flicker nest in the same kind of places, their voices and manner of flight are the same, as are their methods of feeding, and practically their food. The differences of plumage can be certainly distinguished only when the bird is near. The western species has one habit which the eastern one rarely shares, that of pecking holes in cornices and cupolas in order to prepare a winter home. As most of the eastern flickers migrate in winter, the few that remain usually find lodging places in trees. In California, where the birds do not migrate in winter, much complaint has been made against them for disfiguring and injuring buildings.

For the investigation of the food of the red-shafted flicker 183 stomachs were available. They were collected in 10 States and in British Columbia, but more than three-fourths of them came from California. They are distributed through every month of the year, but the warmer seasons are represented by entirely too few. The food was found to consist of 67.74 per cent of animal matter to 32.26 of vegetable. This is over 6 per cent more animal food than is eaten by the eastern species. This difference occurs almost entirely in the winter months, when, in the East, the ground is more or less covered with snow and insects are not readily obtained, while seeds and berries are still accessible.

*Animal food.*—Useful Coleoptera, i. e., predaceous ground beetles, amount to 3.89 per cent of the food, but appear to be eaten very irregularly. In January and March they amount to 17 per cent of the food and in November to 7.28 per cent. In two months they barely reach 1 per cent, and in all the others they are but a trace or do not appear at all. This would seem to indicate that these insects are taken only when better food is not at hand. Other beetles amount to 2.66 per cent. They are largely Scarabæidæ or May beetles, most of them in the larval stage. The larvæ live to a great extent in rotten wood and rubbish, and some species that live on plant roots are often turned up by the plow. They seem to form quite a constant element of the food of both species of flicker. Ants are the favorite food of this bird as well as of its eastern relative. They aggregate 53.82 per cent of the food, which is more than 4 per cent higher than the record of *auratus*, though it is doubtful if this

difference would hold with a larger number of stomachs. In May only one stomach of *cafer* was taken, and it was entirely filled with ants. Like those eaten by *auratus*, these ants are to a great extent taken from the ground, and the usual quantity of sand was found with them. Ants were found in 127 of the 183 stomachs, and 23 contained no other food. Besides the sand ants, some of the large species that live in decaying trees and logs were eaten. These of course are dug out of their burrows. Hymenoptera other than ants are eaten by this bird so rarely as to be negligible.

Hemiptera, or bugs, constitute 1.84 per cent of the flicker's diet, but they are so far from being a favorite food that they were found in the stomachs collected in only 4 months—January with 1.92 per cent, April with 12.50 per cent, June with 7.50 per cent, and October with 0.14 per cent. In each of these months the insects were contained in only one stomach and in April and June were all cicadas, or harvest flies, but in the January stomach they consisted of those curious and delicate looking creatures called lace bugs (*Tingitidæ*). Caterpillars amount to 2.12 per cent of the food and are mostly eaten in the winter and spring months. This is probably owing to the fact that the species taken are mostly wood borers and are dug out of decaying wood in the colder season. March is the month of greatest consumption with 9.11 per cent, and December next with 8.84 per cent. The amount in the other months is small.

Orthoptera aggregate 1.45 per cent and consist of crickets with a few bits of grasshoppers and locusts. They are all taken from October to February inclusive, which shows that this bird, although so terrestrial in its habits, does not join in the grasshopper feast in summer. White ants (*Termes*), a few other insects, and spiders collectively amount to 1.96 per cent and complete the animal food. *Termes* are very similar in habits to the true ants, and are often found and devoured by woodpeckers in their search for ants. Like true ants, white ants do much mischief by boring into timber, and are not infrequently found in the woodwork of buildings, which they sometimes greatly injure, even to the extent of threatening the stability of the structure.

The following insects were identified in the stomachs:

#### COLEOPTERA.

*Pterostichus permundus*.  
*Eurarthrus orbatulus*.  
*Anasa insignis*.  
*Calathus ruficollis*.  
*Platynus maculicollis*.  
*Axinopalpus bipagiatus*.  
*Harpalus herbiivagus*.

*Harpalus* sp.  
*Anisodactylus dilatatus*.  
*Anisodactylus picus*.  
*Chazidium histaroides*.  
*Diabrotica soror*.  
*Anthrenus* sp.  
*Calandrinus grandicollis*.

## HYMENOPTERA (ANTS).

<i>Formica subpolita.</i>	<i>Cremastogaster lineolata.</i>
<i>Formica neorufibarbis.</i>	<i>Cremastogaster</i> sp.
<i>Formica obscuriventris.</i>	<i>Solenopsis geminata.</i>
<i>Formica obscuripes.</i>	<i>Prenolepis imparis.</i>
<i>Formica</i> sp.	<i>Myrmica lobicornis.</i>
<i>Camponotus marginatus.</i>	<i>Myrmica</i> sp.
<i>Lasius americanus.</i>	<i>Messor andrei.</i>
<i>Lasius</i> sp.	

## CRUSTACEA.

Sowbug (*Porcellio scaber*).

## MOLLUSCA.

Snail (*Lymnæa columella*).

*Vegetable food.*—Fruit was eaten to the extent of 10.28 per cent of the red-shafted flicker's food. It appears to be taken rather irregularly, but probably examination of a greater number of stomachs would show it to be a pretty regular article of diet, as the eastern flicker is a constant fruit eater. The greatest amount is taken in November, when it aggregated 31.84 per cent. September stands next with 23.75 per cent. Like the eastern species, this bird eats more fruit in fall and winter than in the warmer months. Grapes were identified in 12 stomachs, and probably nearly all were of cultivated varieties. Domestic cherries were found in one stomach, what was thought to be apple pulp in 9, and fruit pulp not further identified in 11. This is the whole list of cultivated fruit, if we suppose the last item to have been of domestic varieties, but as the greater part of it was taken in the winter or late fall months, probably little harm was done. Wild fruits of 6 varieties were found in 10 stomachs. There appear to be less small fruits or berries available for bird food on the western side of the Rocky Mountains than on the eastern. This is well illustrated in the diet of the two flickers; the eastern species has 31 kinds of wild fruit in its bill of fare to 6 of the western bird. This difference has been noted in the food of other closely allied species, one from the East and the other from the West.

Grain amounts to 2.26 per cent of the food. It was found in January, August, October, and November, and consisted of corn in 14 stomachs, barley in 1, and oats in 1. The barley and oats were taken in January, and were therefore waste grain. The corn must have been obtained from the standing crop, and indeed much of it had been eaten while in the milk. This is not, however, a heavy indictment against the flicker and may well be excused. Seeds of various shrubs and herbs and some rubbish amount to 19.59 per cent, and make up the quota of vegetable food. The largest part of this item consists of seeds of the different poisonous *Rhuses*, commonly

known as poison ivy or poison oak. They are probably eaten in every month, though the one stomach taken in May did not contain any. They were found in 51 stomachs and formed a staple article of diet in all the cooler months, and in December amounted to more than half the food. It is in the distribution of these seeds, if anywhere, that the flickers do harm. Seeds of the nonpoisonous *Rhus* (sumac) and of various weeds were eaten occasionally but not in great quantities. Mast in the shape of acorns was found in 16 stomachs, and is probably very acceptable in the absence of better food.

The following fruits and seeds were identified:

Pigweed ( <i>Amaranthus</i> sp.).	Sumac ( <i>Rhus</i> sp.).
Purslane ( <i>Portulaca</i> sp.).	Pepper berry ( <i>Schinus molle</i> ).
Gooseberry ( <i>Ribes menziesi</i> ).	Woodbine ( <i>Parthenocissus quinquefolia</i> ).
Bur clover ( <i>Medicago denticulatum</i> ).	Dogwood ( <i>Cornus pubescens</i> ).
Filaree ( <i>Erodium cicutarium</i> ).	Elder ( <i>Sambucus glauca</i> ).
Poison ivy ( <i>Rhus radicans</i> ).	Sunflower ( <i>Helianthus</i> sp.).
Poison ivy ( <i>Rhus aromatica</i> ).	Star thistle ( <i>Centaurea calcitrapa</i> ).
Poison oak ( <i>Rhus diversiloba</i> ).	Bur thistle ( <i>Centaurea melitensis</i> ).

*Summary.*—The above analysis of the food shows that the farmer and horticulturist have little to fear from the red-shafted flicker. In its animal diet it does very little harm, and it consumes no more of the products of husbandry than it is entitled to. Its greatest fault is distributing seeds of the poisonous *Rhus*, a sin which it shares with so many other birds that there is no occasion for invidious comparisons.

### IVORY-BILLED WOODPECKER.

(*Campephilus principalis*.)

The ivory-billed is the largest woodpecker inhabiting the United States. Unfortunately, it appears to be rapidly becoming extinct. It originally occupied all the heavily wooded bottom lands from eastern Texas east to the Atlantic and from southern Indiana and Illinois south to the Gulf. At present it is confined to the lower Mississippi Valley and Gulf States and is nowhere numerous.

Only two stomachs of this species have been available for examination. The contents of these are discussed in detail because of the interest that attached to this magnificent but vanishing bird rather than its present economic importance. One stomach contained 32 and the other 20 of the wood-boring cerambycid larvæ, which live by boring into trees. These constituted 37.5 per cent of the whole food. The remainder of the animal food consisted of engraver beetles (*Scolytidæ*) found in one stomach. Of these, three species were identified—*Tomicus arvensis*, *T. calligraphus*, and *T. grandicollis*. The total animal food amounted to 38.5 per cent.

The vegetable food consisted of fruit of *Magnolia foetida* in one stomach, and of pecan nuts in the other. The average for the two was 61.5 per cent. This analysis of food indicates that the species, except for its small numbers, might be of considerable economic value, as the insects forming the animal portion of the food are mostly of an injurious character. These powerful birds are able to reach the wood-boring grubs in places where smaller species fail, and their large bodies require a great quantity of such food. The vegetable portion of the food does not indicate that the bird is likely to attack any products of agriculture, an inference which is strengthened by its shy, retiring habits. It is preeminently a wilderness lover and avoids cleared and cultivated districts.

When we see how much good this woodpecker is capable of doing as a guardian of the forest, it seems deplorable that it should be allowed to be exterminated. Wise legislation, backed by intelligent public opinion, may retard, if not absolutely prevent, the present destruction and allow the bird to regain something of its former abundance. There is plenty of room for this splendid species and much need of its services in the great southern forests.

#### OTHER WOODPECKERS.

Besides the species of woodpeckers whose food has been discussed in the preceding pages, a few stomachs of 5 other species have been received, and, while there are too few to warrant a general discussion of their food, some mention of its most prominent characteristics may be made. The following table gives the number of stomachs of each species and the percentage of animal and vegetable food for each:

Name of species.	Number of stomachs.	Animal food.	Vegetable food.
Texan woodpecker ( <i>Dryobates scalaris bairdi</i> ).....	14	92.07	7.93
White-headed woodpecker ( <i>Xenopicus albolarvatus</i> ).....	14	38.93	61.07
Golden-fronted woodpecker ( <i>Centurus aurifrons</i> ).....	11	54.73	45.27
Gila woodpecker ( <i>Centurus uropygialis</i> ).....	1	40.00	60.00
Gilded flicker ( <i>Colaptes chrysoides</i> ).....	5	88.00	12.00

The Texan woodpecker (*Dryobates s. bairdi*) shows the ruling characteristic of the genus in its food, for the largest item is wood-boring beetle larvæ. Caterpillars are second in importance, and include a number of cotton worms (*Alabama argillacea*), which were found in some stomachs collected in Texas. Ants are next in rank, and these three items make up the bulk of the food.

Half of the animal food of the white-headed woodpecker (*Xenopicus albolarvatus*) is ants, but the most pronounced characteristic of this bird is its fondness for the seeds of pines, which constitute more than half of the food.

The golden-fronted woodpecker (*Centurus aurifrons*) shows a decided taste for grasshoppers, which make up half of its animal food. Its vegetable diet is composed almost entirely of small fruits or berries.

The one stomach of the Gila woodpecker (*Centurus uropygialis*) was largely filled with beetles of the May-beetle family, with a few bones of a lizard. The vegetable part was mere refuse.

The gilded flicker (*Colaptes chrysoides*) shares the characteristic fondness of the genus for ants, which constitute three-fourths of the whole food. The vegetable part was mostly mast.







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# BIRDS OF ARKANSAS

BY

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## LETTER OF TRANSMITTAL

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SIR: I have the honor to transmit herewith, for publication as Bulletin 38 of the Biological Survey, a report on the Birds of Arkansas, by Arthur H. Howell. This report fills an important gap in our knowledge of the avifauna of the Mississippi Valley. In mapping the life zones of the region, the lack of definite information as to the number of species within the State of Arkansas, their distribution, and the nature of their occurrence, whether as visitants, migrants, or strays, has been seriously felt, and the present report is designed to supply the needed data. It is the first detailed study to be published of the avifauna of this State, which is remarkable for the variety and abundance of its bird life, and, although by no means complete, the list marks a long step in advance, adding materially to our knowledge of the birds of the region treated.

Respectfully,

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HON. JAMES WILSON,  
*Secretary of Agriculture.*

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# BIRDS OF ARKANSAS.

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## INTRODUCTION.

Arkansas, although long known as a paradise for sportsmen, has been strangely neglected by ornithologists. No detailed study of the avifauna of the State has hitherto been made and very little on its animal life has been published. In mapping the life zones of the Mississippi Valley the Biological Survey has been hampered by the lack of definite information on the distribution of birds in Arkansas, and in order to obtain the data necessary to complete its maps it was found necessary to make a special investigation of the birds of the State and to compile the published records.

Arkansas is remarkable for the abundance and variety of its bird life, and many interesting problems of distribution are presented as a result of its topography and geographical position. Situated in the heart of the Mississippi Valley, it forms part of the great highway of migration for a large majority of the birds of passage which summer in the Northern States and Canada, while it affords a congenial winter resort for myriads of waterfowl and great numbers of the smaller land birds driven south by the severity of more northern climes.

## PHYSICAL FEATURES.

The most prominent topographic features of the State are the bottom lands of the Mississippi Basin, in which are included the famous Sunken Lands, the Ozark Plateau of the northwest, and the group of more or less isolated mountain ranges south of the Arkansas River sometimes referred to collectively as the Ouachita Mountains.

## THE MISSISSIPPI BOTTOM LANDS.

The so-called Sunken Lands are extensive areas of swamp and overflowed bottom land occupying a large part of Mississippi County and portions of Clay, Greene, Craighead, and Poinsett Counties. The largest of these sunken areas are Big Lake and the broad basin of the St. Francis River, but there are many smaller lakes and sloughs in Mississippi County between Little River and the Mississippi. Many of these lakes, including Big Lake (also Reelfoot Lake, in Tennessee), were formed by the disturbances of the land accompanying the great earthquakes of 1811-1813, usually referred to as the New Madrid earthquake. At that time large forests were prostrated, immense fissures were formed, and profound changes

took place in the bed of the Mississippi River.<sup>1</sup> Evidences of these remarkable disturbances still remain; parts of the bed of Big Lake are covered with a fallen forest of hardwoods of species usually found on high ground, and in Reelfoot and other lakes many dead stubs of old cypresses stand in deep water far from the present shore line. In late summer and fall most of the lakes and rivers in the Sunken Lands shrink greatly in size and some become entirely dry. From November to March this region is populated with countless numbers of waterfowl of many species. In spring and summer it furnishes ideal breeding grounds for wood ducks, cormorants, snakebirds, herons, egrets, and many species of small land birds, but the larger birds, particularly the egrets, have in recent years been greatly reduced in numbers by indiscriminate shooting.

All the counties bordering the Mississippi River are similar in topography to the Sunken Lands, but the proportion of overflowed and swamp land is considerably less. Extensive areas of inundated bottom lands are found also in the valleys of Black River, White River, Cache River, and the Arkansas below Little Rock. The lowlands of the State support a magnificent growth of the finest hardwood timber, much of which is still in its primeval grandeur. Large bodies of cypress and tupelo gum occupy the swamps and wet bottoms along the larger rivers.

In Lonoke, Prairie, and Arkansas Counties considerable tracts of level prairie land, formerly of little value for agriculture, have recently become valuable through the successful introduction of rice farming. Smaller areas of prairie land occur in other parts of the State, chiefly in Sebastian and Logan Counties.

From the bottom lands of the eastern counties the land rises gradually to the westward, becoming hilly through the middle of the State and mountainous in the northwestern and west central parts. In the southwest occur large tracts of pine timber of two species, *Pinus echinata* and *P. taeda*.

#### THE OZARK REGION.

This region occupies the northwestern part of the State north of the Arkansas Valley from Izard, Stone, and Cleburne Counties westward. It is a rough, mountainous area, varying in altitude from 1,000 to 1,800 feet, with a few peaks reaching somewhat above 2,000 feet. The prevailing forests are of deciduous trees, with considerable tracts of mixed pine and hardwood timber. Small land birds are numerous in this region, and several northern-breeding forms, such as the whippoorwill, yellow warbler, brown thrasher, and robin, find their southern limit here.

<sup>1</sup> For a full account of this earthquake, see N. S. Shaler, *Atlantic Monthly*, XXIV, pp. 549-559, 1899. A brief account is given also in Bull. 230 (Part I), Office of Experiment Stations, U. S. Dept. Agric., 1911.



**FIG. 1.—ST. FRANCIS RIVER SUNKEN LANDS. HOME OF WOOD DUCKS, TREE SWALLOWS, SWIFTS, REDWINGS, MARSH WRENS, ETC.**



**FIG. 2.—CANEBRAKE IN PRIMITIVE HARDWOOD FOREST, TURRELL, ARK. HOME OF BACHMAN AND SWAINSON WARBLERS.**



## THE OUACHITA MOUNTAIN REGION.

South of the Arkansas Valley and west of Perry and Garland Counties lies a group of rugged mountain ranges—the highest in the State—known as the Ouachita Mountains. These ranges have a general east and west direction and are steeper and more isolated than the ranges of the Ozarks. Some of the highest peaks are Magazine Mountain (2,800 feet), Fourche Mountain (2,800 feet), Rich Mountain (2,750 feet), Black Fork Mountain (2,650 feet), Petit Jean Mountain (2,600 feet), and Poteau Mountain (2,550 feet).

Both hardwood and pine timber grow on these mountains, the former prevailing in most localities. This region forms the southernmost extension of the Upper Austral Zone in the Mississippi Valley, and several species of birds characteristic of that zone reach their southern limit here.

## LIFE ZONES.

## LOWER AUSTRAL ZONE.

The greater part of the State is occupied by the Austroriparian division of the Lower Austral Zone, which fills all the lowlands and extends up on the mountain sides to an altitude of approximately 1,200 feet in the southern mountains and 800 to 1,000 feet in the northern mountains. A broad area of this zone occupies the Arkansas Valley, and a narrow tongue extends along the upper White River Valley to or beyond the State line.

In this zone cotton is the prevailing crop, and, except where the boll weevil has become abundant, the most profitable. Rice growing has in recent years been introduced on a large scale in the prairie regions with great success. Corn is raised extensively and wheat and oats in less quantity. Fruits have been little cultivated, but a large variety may be successfully grown.<sup>1</sup> One of the most valuable of the native trees is the pecan, whose cultivation might be profitably extended.

This zone is characterized in Arkansas by the presence of a large number of southern plants, mammals, and birds, among which the following are the most conspicuous:

## PLANTS OF THE LOWER AUSTRAL ZONE.

Bald cypress ( <i>Taxodium distichum</i> ).	Overcup oak ( <i>Quercus lyrata</i> ).
Loblolly pine ( <i>Pinus taeda</i> ).	Winged elm ( <i>Ulmus alata</i> ).
Palmetto ( <i>Sabal glabra</i> ).	Planer tree ( <i>Planera aquatica</i> ).
Large cane ( <i>Arundinaria macrosperma</i> ).	Mississippi hackberry ( <i>Celtis mississippiensis</i> ).
Corkwood ( <i>Leitneria floridana</i> ).	Large - leaf magnolia ( <i>Magnolia macrophylla</i> ).
Swamp poplar ( <i>Populus heterophylla</i> ).	Water locust ( <i>Gleditsia aquatica</i> ).
Pecan ( <i>Hicoria pecan</i> ).	Tupelo gum ( <i>Nyssa aquatica</i> ).
Water oak ( <i>Quercus nigra</i> ).	Pumpkin ash ( <i>Fraxinus profunda</i> ).
Basket oak ( <i>Quercus michauxi</i> ).	
Swamp Spanish oak ( <i>Quercus pagodæfolia</i> ).	

<sup>1</sup> See Life Zones and Crop Zones of the United States, Bull. 10, Biol. Survey, pp. 46-49, 1908.

## BREEDING BIRDS OF THE LOWER AUSTRAL ZONE.

Water turkey ( <i>Anhinga anhinga</i> ).	Chuck-will's-widow ( <i>Antrostomus carolinensis</i> ).
Mississippi kite ( <i>Ictinia mississippiensis</i> ).	Bachman sparrow ( <i>Peucaea aestivalis bachmani</i> ).
Black vulture ( <i>Catharista urubu</i> ).	Blue grosbeak ( <i>Guiraca caerulea</i> ).
Little blue heron ( <i>Florida caerulea</i> ).	Painted bunting ( <i>Passerina ciris</i> ).
Florida barred owl ( <i>Strix varia alleni</i> ).	Prothonotary warbler ( <i>Protonotaria citrea</i> ).
Florida screech owl ( <i>Otus asio floridanus</i> ).	Swainson warbler ( <i>Helinaia swainsoni</i> ).
Ivory-billed woodpecker ( <i>Campephilus principalis</i> ).	Bachman warbler ( <i>Vermivora bachmani</i> ).
Southern hairy woodpecker ( <i>Dryobates villosus auduboni</i> ).	Sycamore warbler ( <i>Dendroica dominica albiflora</i> ).
Red-cockaded woodpecker ( <i>Dryobates borealis</i> ).	Mockingbird ( <i>Mimus polyglottos</i> ).
Florida nighthawk ( <i>Chordeiles virginianus chapmani</i> ).	Brown-headed nuthatch ( <i>Sitta pusilla</i> ).

## MAMMALS OF THE LOWER AUSTRAL ZONE.

Cotton mouse ( <i>Peromyscus gossypinus megacephalus</i> ).	Cotton rat ( <i>Sigmodon hispidus</i> ).
Golden mouse ( <i>Peromyscus nuttalli aureolus</i> ).	Louisiana pocket gopher ( <i>Geomys breviceps</i> ).
Rice rat ( <i>Oryzomys palustris</i> ).	Swamp rabbit ( <i>Sylvilagus aquaticus</i> ).
Golden harvest mouse ( <i>Reithrodontomys aurantius</i> ).	Louisiana skunk ( <i>Mephitis mesomelas</i> ).
Swamp wood rats ( <i>Neotoma floridana rubida</i> and <i>N. f. illinoensis</i> ).	Evening bat ( <i>Nycticeius humeralis</i> ).
	Carolina shrew ( <i>Blarina brevicauda carolinensis</i> ).

## UPPER AUSTRAL ZONE.

The Carolinian division of the Upper Austral Zone covers the greater part of the Ozark region and the slopes of the higher Ouachita Mountains above an altitude of approximately 1,200 feet.

In this zone lumbering and fruit raising are the principal industries. Apples are grown very successfully, as well as corn, oats, and hay. Following are some of the most characteristic species occurring in this zone in Arkansas:

## PLANTS OF THE UPPER AUSTRAL ZONE.

Chestnut ( <i>Castanea dentata</i> ).	Swamp white oak ( <i>Quercus bicolor</i> ).
Red oak ( <i>Quercus rubra</i> ).	Umbrella tree ( <i>Magnolia tripetala</i> ).
Scarlet oak ( <i>Quercus coccinea</i> ).	Ohio buckeye ( <i>Æsculus glabra</i> ).
Shingle oak ( <i>Quercus imbricaria</i> ).	Black ash ( <i>Fraxinus nigra</i> ).

## BREEDING BIRDS OF THE UPPER AUSTRAL ZONE.

Ruffed grouse ( <i>Bonasa umbellus</i> ). <sup>1</sup>	Goldfinch ( <i>Astragalinus tristis</i> ).
Black-billed cuckoo ( <i>Coccyzus erythrophthalmus</i> ).	Towhee ( <i>Pipilo erythrophthalmus</i> ).
Hairy woodpecker ( <i>Dryobates villosus villosus</i> ).	Scarlet tanager ( <i>Piranga erythromelas</i> ).
Whippoorwill ( <i>Antrostomus vociferus</i> ).	Yellow warbler ( <i>Dendroica aestiva</i> ).
Phoebe ( <i>Sayornis phoebe</i> ).	Ovenbird ( <i>Seiurus aurocapillus</i> ).
	Brown thrasher ( <i>Toxostoma rufum</i> ).
	Robin ( <i>Planesticus migratorius</i> ).

## MAMMALS OF THE UPPER AUSTRAL ZONE.

Woodchuck ( <i>Marmota monax</i> ).	Weasel ( <i>Putorius</i> sp.).
Attwater cliff mouse ( <i>Peromyscus boyleyi attwateri</i> ).	Spotted skunk ( <i>Spilogale</i> sp.).

<sup>1</sup> Extirminated.

## ECONOMIC VALUE OF BIRDS.

In the early days of the settlement of this country birds were considered of value to man chiefly as a source of food. Modern scientific investigation, however, has demonstrated that most birds are of infinitely more value to the agriculturist through their destruction of noxious insects, destructive mammals, and weed seed.

The great abundance of insects and the widespread injury to crops caused by a host of herbivorous species are well known to every farmer, but the important service rendered by birds in keeping within bounds these destructive swarms is less widely recognized. "The examination of birds' stomachs," says Prof. Beal, "has shown that nearly all of the smaller species, and many of the larger ones, such as the crow, subsist largely upon insects in the summer time, while rearing their young, and, as a general rule, all the small birds feed their nestlings on this food, no matter what the adults may eat."

In fields and gardens the birds most useful in the war against insects are the robin, bluebird, catbird, indigo bird, chipping sparrow, the orioles, blackbirds, meadowlarks, flycatchers, and quail. Swallows, martins, swifts, and nighthawks supplement the work of ground-feeding species by capturing insects in the air as they fly over the fields, and in the orchard and forest a host of keen-eyed foragers, including woodpeckers, nuthatches, wrens, chickadees, warblers, vireos, tanagers, and cuckoos, search out and destroy great numbers of insects destructive to the bark and foliage of fruit and forest trees.

Among the special services rendered by birds in the South may be mentioned the destruction of crawfish by various herons, of mosquitoes by many species, chiefly shorebirds, swifts, swallows, night-hawks, and flycatchers,<sup>1</sup> and of the cotton boll weevil by no fewer than 53 species. The relations of birds to this latter insect are of particular interest in view of the rapid spread of the pest in Arkansas. Investigations in Texas and Louisiana have shown that many birds feed extensively on this weevil, and some species, for instance the orioles, show a special liking for it and have learned how to find it in its hiding places in the cotton "squares."

Besides the orioles, the birds most useful in keeping down the weevil in summer are swallows, nighthawks, flycatchers, and the painted bunting, while in winter splendid service is rendered by meadowlarks, blackbirds, pipits, wrens, and Savannah sparrows, which seek out and destroy the weevils in their hibernating quarters. Cotton growers should see that every species of bird known to feed on the weevil is protected on their lands and should, in addition, strive to increase the numbers of such species as martins and wrens by providing nest boxes for their accommodation.

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<sup>1</sup> Cf. McAtee, *Auk*, XXVIII, pp. 141-142, 1911.

Perhaps the most maligned birds in this country are the hawks and owls. A deep-seated though baseless prejudice against them has persisted to the present day, although it is now nearly 20 years since the Biological Survey demonstrated, as a result of hundreds of stomach examinations, that most of this prejudice is unfounded and that in reality nearly all of our hawks and owls confer a decided benefit on the farmer by destroying field mice, rats, rabbits, other rodents, and insects. The only birds of prey found in Arkansas which are not beneficial are the duck hawk, the sharp-shinned hawk, the Cooper hawk, and the fish hawk.

#### GAME RESOURCES AND LEGISLATION.

In the abundance of its game birds Arkansas holds an enviable position among the States of the Union, but in the adoption of measures for their conservation she has lagged somewhat behind her sister States. In pioneer days quail, prairie chickens, wild turkeys, passenger pigeons, the mallard and other ducks, and wild geese were so abundant that there seemed to be no danger of their extermination. To-day the pigeons are exterminated, the prairie chickens are on the verge of extinction, and turkeys have become very scarce save in a few specially favorable regions.

The history of the exploitation of these game resources strikingly illustrates the effect which the bird life of a State may have on the development of its legislation and on its attitude toward game protection.

Market hunters were early attracted to the game fields, and with the development of railroads and the introduction of cold storage in the handling of game, came an unexpected drain on the resources of the State. Quail, prairie chickens, pigeons, and ducks were trapped or killed in enormous numbers to supply the markets of St. Louis, Chicago, and other cities, and considerable trade was built up in handling game chiefly for shipment to other States. To regulate this traffic a law was passed in 1875 requiring a \$10 market-hunting license of nonresident hunters. The first law fixing seasons for hunting game birds was enacted in 1885, and at the same time protection was extended to the nests and eggs of all wild birds except birds of prey, crows, and blackbirds. In 1889 export of game from the State was prohibited, and in 1897 the market-hunting license was increased to \$25. In the same year, through the public-spirited efforts of Mrs. L. M. Stephenson, of Helena, was enacted the first comprehensive law protecting nongame birds and one of the first laws of its kind in any of the Southern States. In 1903, not only was killing of game for sale and the sale itself prohibited, but the privilege of hunting was restricted to residents of the State. No close season for ducks or geese has ever been established, and no restriction has been placed on the numbers of these birds which may be legally killed. It is evident, therefore,

that the abundance of game has caused less attention to be paid to legislation regarding hunting seasons and methods of hunting, while numerous restrictions have been placed on shipment, sale, and market hunting, particularly by nonresidents.

These drastic laws were not permitted to stand unchallenged. The nonresident license law of 1875 was set aside by the circuit courts of Craighead and Poinsett Counties in 1887,<sup>1</sup> and in 1904 the act passed the previous year prohibiting nonresidents from hunting in the State was carried to the supreme court of Arkansas, and this court held the statute unconstitutional in so far as it prevented property owners from hunting on their own land.<sup>2</sup> The nonexport law enacted in 1893 authorized express companies to examine packages suspected of containing game and held them responsible for the transmission of such shipments out of the State. This broad power of examining shipments with the accompanying responsibility was apparently not relished by the carriers, and a few years ago became the basis of a test case carried to the supreme court. The court sustained the law and held the express companies liable for game shipments intrusted to their care.<sup>3</sup>

Restrictions on the shipment of game and on hunting by nonresidents have aroused most opposition in the northeast section of the State, particularly in the Sunken Lands, where enormous numbers of waterfowl attract not only market hunters but sportsmen from other States. Several wealthy clubs have acquired property at favorable points in the region and have erected expensive club houses on their grounds. In the attempt to reap the greatest amount of benefit from the enormous numbers of birds which annually visit this section, there has been a constant effort on the part of club members and market hunters to secure legislation favorable to their interests. This has resulted in bringing about conditions far from satisfactory, and has left the game without that measure of protection which is considered essential in other States.

#### SOURCES OF INFORMATION.

Audubon was probably the first naturalist to visit the State. He passed through Arkansas at various times between the years 1811 and 1819, but no account of his expeditions has been preserved, and the published results consist only of scattered records in his "Birds of America" and the description there of a new species of flycatcher (*Empidonax traillii*), which he procured on the prairies of the Arkansas River.

In 1819 Thomas Nuttall made a journey down the Mississippi to the mouth of the Arkansas and up the Arkansas to Fort Smith, but

<sup>1</sup> American Field, XXXVII, p. 49. 1892; XXXVIII, p. 3. 1892.

<sup>2</sup> State v. Mallory, 83 S. W. 955.

<sup>3</sup> Wells Fargo Express Co. v. State, 96 S. W. 189.

he was primarily a botanist and his account of the trip, while abounding in interesting descriptions and valuable plant notes, contains only casual allusions to the birds seen along the route.

In 1820 Maj. Long's exploring party, on its return from the Rocky Mountains, crossed the State from Fort Smith to Little Rock and thence overland to Cape Girardeau, Mo., but with one or two exceptions the published account of the expedition contains no reference to Arkansas birds.

Several of the later Government exploring expeditions to the Western States made Fort Smith their point of departure, but on account of the location of that place so near the western boundary of the State practically no observations were made until the exploring parties had crossed into what is now Oklahoma.

The ornithology of Arkansas remained practically unknown until the later years of the last century. Frequent references to the birds of the State, chiefly game birds, are found in the pages of *Forest and Stream* and *American Field*, and occasional short articles have appeared in the *Auk* and other natural history magazines, but only three local lists treating of Arkansas birds have been published. The first of these is a brief account by H. S. Reynolds of 29 species observed in White County in the winter of 1876-77.<sup>1</sup> In the summer of 1881 O. P. Hay made a few observations near Hopefield, on the Mississippi River, and in a list, published the following year, recorded 29 species from the State.<sup>2</sup> In 1902 N. Hollister published a list of 51 species of winter birds, which he observed in 1899 and 1900, chiefly on the Grand Prairie of Arkansas County.<sup>3</sup> This paper supplied four additions to the State list and many valuable distribution notes.

When Prof. W. W. Cooke began the study of bird migration in the Mississippi Valley, in 1882, only a single observer, Prof. F. L. Harvey, of Fayetteville, was found in Arkansas to contribute notes. In 1884 one more observer, W. A. Monroe, of Newport, was added to the force, and in 1889 and 1890 C. E. Pleas, of Clinton, furnished valuable notes on the birds of the mountain region near that place. Some of the data furnished by these observers were published in Prof. Cooke's *Report on Bird Migration in the Mississippi Valley*.<sup>4</sup> As early as 1886 Mrs. L. M. Stephenson, of Helena, began to record observations on the birds of that locality, and from 1894 to the present date she has furnished each year to the Biological Survey detailed notes on migration. The data supplied by this series of observations have proved of the greatest value in the preparation of the present report, furnishing many new records and the most important migration dates at present available.

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<sup>1</sup> *Amer. Nat.*, XI, pp. 307-308, 1877.

<sup>2</sup> *Bull. Nuttall Orn. Club*, VII, pp. 89-94, 1882.

<sup>3</sup> *Wilson Bull.*, IX, pp. 10-15, 1902.

<sup>4</sup> *Bull. 2, Div. Econ. Ornith. [Biol. Surv.] U. S. Dept. Agric.*, 1888.

In the spring of 1910 Mr. Walter G. Savage moved to Delight, Pike County, and at once began to make observations on the birds of that region. His notes, based in many cases on specimens which he collected, have added much to our knowledge of the birds of the southwestern part of the State. In the winter of 1910-11 Mr. G. Dallas Hanna spent about six weeks at Van Buren collecting birds, chiefly the smaller land birds. His specimens have been examined and identified by the Biological Survey, and these records, together with his notes on 65 species, have added 11 forms to the State list and many new facts on the distribution of winter birds.

Most of the information on breeding ranges contained in the present report was gained by the writer during a collecting trip extending from April 28 to July 7, 1910. The principal localities at which observations were made are as follows: Mammoth Spring, Cotter, Lake City, Walker Lake (Mississippi County), Turrell (Big Creek Station), Stuttgart, McGehee, Wilmot, Camden, Delight, Womble, Mena, Rich Mountain (Polk County), Pettigrew, and Conway.

Several other members of the Biological Survey staff have visited the State for short periods. Edward A. Preble collected at Fort Smith and Fayetteville from September 15 to October 1, 1892. B. H. Dutcher worked at Hardy, Batesville, Beebe, and Benton in April, 1894. C. E. Brewster visited Big Lake for a few days in November, 1909, and December, 1910, and Wappanocka Lake (Turrell) on December 20, 1910. W. L. McAtee collected from November 12 to 24, 1910, at Mud Lake (St. Francis County), Wappanocka Lake, and Menasha Lake and made observations at Big Lake from June 20 to 23, 1911.

#### NUMBER OF SPECIES.

In the list which follows 255 species and subspecies are accredited to the State. No bird is admitted to the list unless there is an actual record of its occurrence, based on a specimen, a published record, or a report by a competent observer.

On account of the very limited number of observers many species have escaped detection which, by reason of their known range in adjacent regions, must certainly occur in the State. These species, 35 in number, are included in a hypothetical list, distinguished from the species actually recorded by being printed in smaller type.

Dividing the list of birds actually and probably occurring in the State into several categories, we find that 67 species or subspecies may be considered as permanent residents, either nonmigratory birds breeding within its limits or migratory species that occur in both summer and winter; 75 are summer resident breeding species; 60 are winter residents; 69 are transients—that is, migrating species occurring in either spring or fall; and 19 occur irregularly as

accidental visitors. Many species listed as summer residents and winter residents occur also more abundantly as transients. More thorough field investigations will doubtless increase the number of birds known to occur in the State to about 300 forms.

#### LIST OF SPECIES.

##### Pied-billed Grebe. *Podilymbus podiceps*.

This little grebe, known locally as "didapper" and "hell-diver," may be found during the spring and fall migrations on almost any lake or slough in the State. In the nesting season, however, it is rare, and the only record at hand is that of a bird which I saw at Wilmot on June 29. The last migrants at Clinton were reported November 5 (Pleas, 1890), but a few were seen between November 15 and 21 (McAtee, 1910) at Mud Lake, St. Francis County; Turrell, Crittenden County; and Menasha Lake, Mississippi County. It is possible that small numbers may spend the winter in the Sunken Lands.

The demand for grebes' feathers for millinery has worked havoc among the larger species, and doubtless this little bird has suffered to some extent with the rest; but its small size, retiring habits, and wonderful diving powers preserve it in a measure from destruction, and under present conditions it is likely to hold its own. It is a harmless and interesting bird and should be everywhere protected.

##### Loon. *Gavia immer*.

The loon breeds from the Arctic Ocean south to Iowa and Illinois and winters from southern Canada to the Gulf coast. It probably occurs in Arkansas as an uncommon spring and fall migrant and has once been reported as a winter resident—at Clinton, in 1890.

##### Herring Gull. *Larus argentatus*.

The herring gull, the largest of its family found in the Mississippi Valley, is widely distributed in both North America and Europe, chiefly along the seacoasts and on large lakes and rivers. It has been reported in winter near Clinton and probably occurs regularly in migration. Mr. S. C. Dowell, of Walnut Ridge, has a specimen which was killed in the vicinity of that town.

##### Ring-billed Gull. *Larus delawarensis*.

The ringbill breeds in Canada and the northern United States and winters from the Great Lakes south to Mexico and Cuba. The only definite record from Arkansas is that of a bird in the possession of Mr. S. C. Dowell, which was killed near Walnut Ridge, but the species is doubtless a fairly common migrant in both spring and fall.

[Franklin Gull. *Larus franklini*.

This small black-headed gull is a common summer resident in the upper Mississippi Valley from Iowa north to southern Canada, and winters from the Gulf coast southward to South America. It undoubtedly occurs in Arkansas in migration.]

Bonaparte Gull. *Larus philadelphia*.

This species, one of the smallest of the gulls, is probably a regular, though uncommon, transient visitant. No recent records of its occurrence are at hand, but Audubon mentions a specimen which he shot November 12, 1820, on the Mississippi River, a few miles below the mouth of the Arkansas.<sup>1</sup>

[Forster Tern. *Sterna forsteri*.

This tern is widely distributed in the Mississippi Valley, breeding on the coasts of Louisiana and Texas and also from Nebraska and Illinois northward. It is recorded as a regular transient visitant in Missouri, and probably occurs in Arkansas.]

[Least Tern. *Sterna antillarum*.

The least tern is known as a summer resident in the Mississippi Valley, formerly common, now very rare as a result of persecution by plumage hunters. It formerly bred north to Iowa and Nebraska and has been observed in summer in recent years at Tallulah, La.<sup>2</sup> Oberholser found it fairly common in June, 1902, near Texarkana, Tex., within a few miles of the Arkansas line. In former years it undoubtedly occurred in Arkansas and it may still be found in the State.]

[Black Tern. *Hydrochelidon nigra surinamensis*.

The black tern breeds from Missouri and Ohio northward to northern Canada and winters south of the United States. It undoubtedly occurs regularly in Arkansas as a spring and fall migrant.]

Water Turkey. *Anhinga anhinga*.

The water turkey or "snake bird" is fairly common locally in the swamps of eastern Arkansas. It breeds at Helena, Wilmot, and Walker Lake and has been recorded from Osceola and Newport—at the last-named place in winter.

The birds are frequently hunted for food or sport, and as they are easily approached, their numbers have been much reduced. If not protected by the enforcement of the existing game law, the species is likely to be exterminated. A bird so harmless and interesting should be preserved for future generations.

Double-crested Cormorant. *Phalacrocorax auritus auritus*.

Cormorants were formerly abundant in the rivers and swamps of eastern Arkansas, but as a result of the drainage and settlement of the land they are now found only in the wilder and more remote sections, where they are comparatively free from persecution. A large colony, probably the only large one now remaining in the State,

<sup>1</sup> Orn. Blog., IV, 212, 1838.<sup>2</sup> Beyer, Allison, and Kopman, Auk, XXIV, p. 315, 1907.

breeds in a rookery at Walker Lake, Mississippi County, in company with great blue herons and water turkeys. When I visited this rookery the first week in May, 1910, I found the cormorants sitting on their nests in the tops of the tall cypresses growing in the lake. The nests, of which there were between 100 and 200, were placed in crotches either close to the trunks or some distance out on the limbs and were compactly built of green cypress twigs with a few strips of bark as a lining. Most of the nests examined contained three or four bluish eggs, but in one were four little naked coal-black cormorants a few days old. The number of nests in a single tree varied from 1 to 6—usually 3 or 4—and in many instances the cormorants shared the tree with several great blue herons. Specimens taken in this colony are referable to the northern form, and this is probably the southern limit of its breeding range.

Cormorants feed chiefly upon fish and often fly long distances to obtain their favorite food. With the approach of winter many of the birds seek more southern waters, but some remain till cold weather. Migrants were observed at Helena between September 15 and October 14, 1894 (Stephenson), and quite a number on Menasha Lake November 22–24 (McAtee, 1910). In 1882 they were reported as very abundant along White River near Crocketts Bluff.<sup>1</sup> Many persons call this species “water turkey” as well as the species properly so named. Cormorants may be easily recognized by their hooked bill and their uniform glossy black color.

**White Pelican.** *Pelecanus erythrorhynchos.*

White pelicans were formerly very abundant in migration along the larger rivers and they still visit the State in some numbers. In 1895 and 1896 Mrs. L. M. Stephenson reported flocks of 100 to 300 at Helena between September 3 and November 9. Mr. W. D. Brooks, of Turrell, states that numbers of them come to the lake at that place each year in August, and one was killed there about November 15, 1910. Occasional flocks are seen on Walker Lake and on Big Lake, and the birds doubtless occur regularly in small numbers in all parts of the Sunken Lands.

**Merganser.** *Mergus americanus.*

This duck, known commonly as “shelldrake,” is probably an uncommon winter resident. Audubon speaks of observing it on the Arkansas River,<sup>2</sup> and Mrs. Stephenson reports it on the authority of local hunters at Helena, but definite records of its recent occurrence are lacking.

**[Red-breasted Merganser.** *Mergus serrator.*

The red-breasted merganser is a common winter resident in Louisiana and a rare winter resident in Missouri. It should be found occasionally in Arkansas.]

<sup>1</sup> Forest and Stream, XVIII, p. 27, 1882.

<sup>2</sup> Birds of Amer., VI, p. 387, 1843.

**Hooded Merganser.** *Lophodytes cucullatus.*

A fairly abundant summer resident throughout the Mississippi Valley, the hooded shelldrake or "sawbill" breeds in favorable localities in Arkansas, nesting in hollow trees, after the manner of the wood duck. Strong-flying young were seen at Big Lake June 22, 1911 (McAtee). It is common in migration on lakes and sloughs, and is reported to occur plentifully on Big Lake from October to March. McAtee found it common at Mud Lake November 14 and at Turrell November 17-19, 1910. The food of this species is chiefly crawfish, frogs, small fishes, and insects.

**Mallard.** *Anas platyrhynchos.*

The mallard is the most abundant duck and the most important game bird in the State. It has been the chief factor in the development of extensive market hunting and shipping interests and in the growth of several large and wealthy sportsmen's clubs.

The first fall migrants arrive about the middle of October, but the main flight occurs in November, and the species is found in numbers until the middle of April, although the majority go north in March. The shallow lakes and overflowed bottom lands of the eastern part of the State are particularly attractive to this bird, and on these waters it reaches its greatest abundance. Many thousands are killed each season by market hunters and thousands more by local gunners and members of sportsmen's clubs. Widmann states that in the winter of 1893-94 150,000 ducks, four-fifths of which were mallards, were sent to market from the Big Lake region.<sup>1</sup> In spite of the tremendous annual slaughter the species is still found in great abundance, but according to experienced gunners is decreasing yearly in numbers. It was recorded as abundant on the Grand Prairie around Stuttgart in November and January (Hollister, 1899 and 1900) and at Mud Lake, Menasha Lake, and Wappanocka Lake in November (McAtee, 1910). It winters in small numbers in the vicinity of Fayetteville (Harvey), and has been reported from Clinton in February (Pleas) and from Van Buren in December (Hanna). The food of the mallard consists largely of the seeds and stems of water plants (such as duckweed, pondweed, and hornwort), together with acorns, beechnuts, and various grains. The birds are fond of both corn and rice, and when living near grainfields are said to feed in them regularly. They consume more or less animal food, such as snails, aquatic insects, an occasional meadow mouse or frog, and will not reject even dead fish or other offal. In the timbered sloughs of eastern Arkansas the mallard feeds extensively on acorns, but on lakes in the Sunken Lands lives to a great extent on seeds and water plants.

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<sup>1</sup>Auk, XII, p. 354, 1895.

**Black Duck.** *Anas rubripes.*

Although common along the Atlantic coast, the black duck is comparatively rare in the Mississippi Valley. A specimen taken in Mississippi County November 5, 1887, has been recorded by Mr. William Brewster.<sup>1</sup> McAtee saw a few at Mud Lake November 13 and 14, many at Menasha Lake November 21 and 22, and one at Turrell November 19 (1910), and took specimens at each of these localities.

**Gadwall.** *Chauleasmus streperus.*

The gadwall, known frequently as "gray duck" or "red wing," is a common winter visitant in the State. Mr. O. Widmann speaks of it as plentiful on Big Lake<sup>2</sup> and Mrs. Stephenson reports it at Helena. McAtee found it common at Mud Lake November 13-15 and abundant at Turrell November 17-19 (1910). It was common at Menasha Lake December 10, 1909, when 50 were killed by the club members. According to Goss, this bird feeds upon insects, snails, tadpoles, crawfish, bulbous roots, tender blades of grass, and cereals.<sup>3</sup> On Big Lake it is said to feed in open water in company with coots (*Fulica americana*), and its food there consists largely of seeds of aquatic plants.

**Baldpate.** *Mareca americana.*

The baldpate or American widgeon is a common migrant in the Mississippi Valley, breeding from Kansas and Wisconsin northward and wintering mainly from the Gulf States southward. It doubtless occurs regularly in Arkansas in fall and spring, but there are few available records. Hollister states that he saw very few in the bags of market hunters at Stuttgart, and McAtee secured only two specimens in November—one at Mud Lake, November 14, and one at Turrell, November 19. C. E. Brewster saw a few on Big Lake, December 17, 1910, but it is not usually common there. The food of the baldpate is said to consist of roots and seeds of aquatic plants, water insects, beechnuts, etc. It is accused of robbing the canvas-back and other diving ducks of the food which these birds bring to the surface.

**Green-winged Teal.** *Nettion carolinense.*

The green-winged teal is an abundant migrant in both spring and fall, and small numbers spend the winter in the State. Southbound migrants are first seen in early October, and by the middle of November the species is abundant on the lakes and sloughs of the Sunken Lands. A few remain on Big Lake all winter, but most of them leave with the coming of severe weather. The first small flight was noted

<sup>1</sup> Auk, XIX, p. 188, 1902.

<sup>2</sup> Auk, XII, p. 355, 1895.

<sup>3</sup> Birds of Kansas, p. 59, 1891.

at Crocketts Bluff on October 22 (1882),<sup>1</sup> and Savage saw a flock of seven at Delight on November 9 (1910). McAtee found the species abundant by the middle of November at Mud Lake and Wappanocka Lake, but Hollister states that few were seen at Stuttgart in January. In spring the first arrivals have been noted at Fayetteville March 20, but they doubtless reach the lowlands of the State in February. The food of this teal consists principally of the seeds of aquatic plants (including various grasses, sedges, wild rice, and pondweed), small acorns, fallen grapes or berries, aquatic insects, and small snails.

**Blue-winged Teal.** *Querquedula discors.*

The bluewing is a common transient visitant, but as it migrates south before the fall hunting season is fairly under way comparatively few are killed by market hunters or by sportsmen. The earliest migrants reach Arkansas in late August or early September, becoming common the last of September or first of October, and by November nearly all have passed southward to their winter home. In mild winters a few may remain in the State, as in the winter of 1893-94, when they were reported in small numbers from Big Lake.<sup>2</sup> A writer in the American Field speaks of their occurrence in December on Rose Lake, Crawford County.<sup>3</sup> In spring this is one of the latest ducks to migrate, the majority passing north between March 15 and April 15. Many linger even later than that, and I noted a small flock on the St. Francis River, north of Bertig, April 29. This duck feeds upon the seeds, roots, and tender blades of water plants, and is said to be especially fond of wild rice. It eats also snails and insects.

**Shoveler.** *Spatula clypeata.*

The shoveler, or spoonbill, as it is usually called, is a fairly common migrant and an uncommon winter resident. McAtee took a few specimens at Mud Lake, Wappanocka Lake, and Menasha Lake between November 14 and 22, and it is reported in December from the latter place and from Rose Lake, Crawford County.<sup>4</sup> Two were killed on Big Lake, December 17 (1910), and a few are found there throughout the winter (Eason). Its principal breeding range is in the prairie region from Iowa and South Dakota northward to the Saskatchewan, but since it has once been found breeding in east Texas it may occasionally nest in Arkansas. The food of this duck includes seeds of various water plants, snails, earthworms, and aquatic insects.

<sup>1</sup> "Byrne," Forest and Stream, XIX, p. 286, 1882.

<sup>2</sup> Widmann, Auk, XII, p. 364, 1895.

<sup>3</sup> "Old Timer," Am. Field, LII, p. 181, 1899.

<sup>4</sup> Amer. Field, LII, p. 181, 1899.

**Pintail.** *Dafila acuta.*

The pintail, or "sprig," is an abundant migrant, especially in spring, and an uncommon winter resident. First arrivals in fall have been noted at Osceola October 5, and by November 11 the birds were common on Mud Lake. At Wappanocka Lake McAtee found them abundant November 17-19, and at Stuttgart Hollister recorded a few seen in January. Mr. W. B. Eason says of the pintail on Big Lake: "Not many stop here on the southward flight, but on the return in February there are thousands of them, and they furnish good shooting for several weeks." The first north-bound migrants were observed at Fayetteville January 27 and the last on March 20. This species feeds on the seeds and stems of rushes, duckweed, and other aquatic plants, snails, and insects. It is said to be fond of beechnuts and acorns.

**Wood Duck.** *Aix sponsa.*

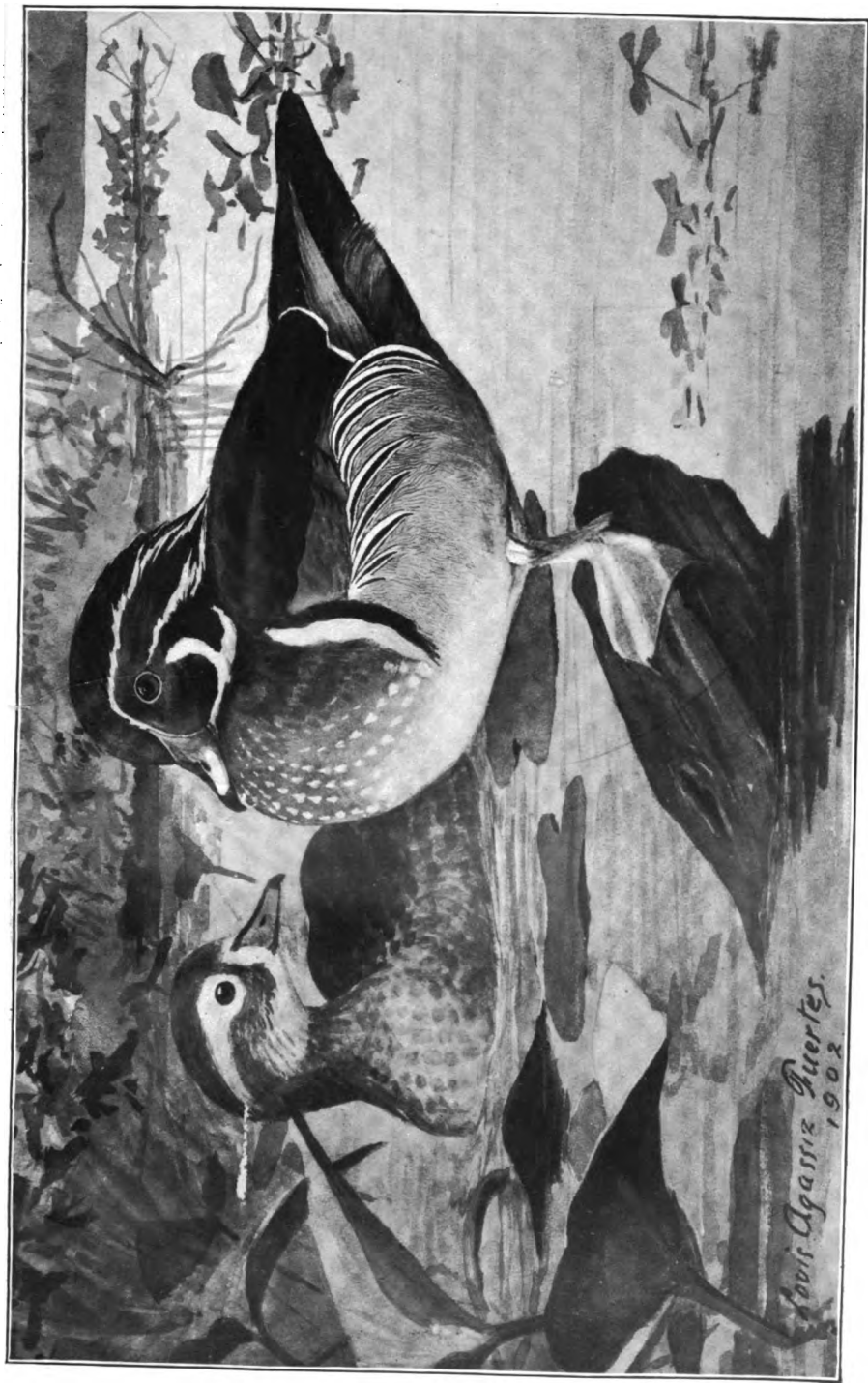
This handsome duck is one of the commonest of its family in both summer and winter. Formerly abundant in many parts of the State, its numbers have been greatly reduced by constant persecution, and it is now rare or absent in many localities. In the heavy swamps of the eastern counties it is still common, but will not long remain so unless protection is afforded it by both law and public sentiment. At present it may be killed at any time and gunners often begin shooting the young birds in June, when they are not more than two-thirds grown. In the Sunken Lands it finds ideal nesting haunts, and there it breeds abundantly, nesting in hollow trees over water. It nests also, but less frequently, in swampy bottoms throughout the State, having been observed at Clinton, Fayetteville, Newport, Turrell, Big Lake, Helena, Wilmot, and Alma. In winter it has been reported from Alma, Fayetteville, and Stuttgart (3 killed February 8); but, as at other seasons, is probably most numerous in the big swamps of the northeastern counties. Hollister reported it very common on Bayou Meto, Arkansas County, in November, and McAtee found it in small numbers at Turrell November 17-19. The food of the wood duck consists of the seeds and leaves of aquatic plants (such as the water lily, pondweed, and wild rice), acorns, beechnuts, chestnuts, wild fruits, and insects.

**Redhead.** *Marila americana.*

The redhead occurs in favorable localities as a regular and not uncommon migrant and winter resident, preferring usually the deeper lakes and streams for its feeding grounds. It has been reported as a migrant at Clinton and Helena and was observed in numbers by McAtee at Menasha Lake November 22-24. A writer in the American Field says it is occasional in winter (December) on Rose Lake, Crawford County,<sup>1</sup> and Mr. W. B. Eason reports a few

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<sup>1</sup> "Old Timer," Amer. Field, LII, p. 181, 1899.



THE WOOD DUCK.



occurring on Big Lake all winter. Hanna saw a flock of 30 at Van Buren November 28. Audubon states that the food of this duck consists of small fishes, tadpoles, snails, acorns, beechnuts, and blades of grass. To this list should be added insects and the seeds and stems of water plants.

**Canvasback.** *Marila valisineria.*

The famous canvasback occurs as a moderately common migrant and a few remain through the winter. It breeds from Minnesota and Nebraska northward, and on its southward migration reaches Arkansas usually in November. McAtee found it numerous on Wappanocka Lake November 17-19, 1910, but it is not usually common there. One specimen was taken also on Menasha Lake November 23, and the species has been reported from Big Lake (a few all winter), Osceola, and Helena. The canvasback feeds mainly on the seeds, tubers, and stems of various water plants (such as pondweed, eel grass, arrowhead, and rushes), and consumes also some mollusks, crustaceans, and insects.

**Lesser Scaup Duck.** *Marila affinis.*

The scaup, or "blue-bill," as it is frequently called, occurs regularly in moderate numbers as a winter resident. On Menasha Lake one was taken December 1 (1909), and seven on November 22 and 23 (1910). It is reported plentiful at Big Lake about the middle of November (Eason), and one was killed there December 17 (1910). Kumlien reports "a few seen in Arkansas near Ft. Gibson, Ind. Ter.,"<sup>1</sup> probably not far from Fort Smith.

**Ring-necked Duck.** *Marila collaris.*

The ring-neck or "black jack" is a common migrant and winter resident. It occurs abundantly in autumn on the waters of the Sunken Lands and less numerously on other lakes and sloughs. McAtee found it common at Mud Lake November 13-15 and at Turrell November 17-19. It was abundant at Menasha Lake between November 21 and December 10, 13 birds having been killed there on the latter date. On Big Lake in November and December it is often the most abundant duck, and gunners there frequently kill as many as 50 birds in a few hours. A few remain all winter (Eason). The food of the ring-neck consists mainly of the seeds and stems of pondweed, hornwort, and other aquatic plants, with many nymphs and larvæ of water insects.

**Golden-eye.** *Clangula clangula americana.*

This hardy northern duck is of rare occurrence south of Missouri and Illinois, but is occasionally found in Arkansas in winter. C. E. Brewster observed several on Big Lake December 17, 1910, and Mr. W. B. Eason, custodian of the Big Lake Club, reports a good many there in January, 1911. There are no other records from the State.

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<sup>1</sup> Field and Forest, II, p. 130, 1877.

**Bufflehead.** *Charitonetta albeola.*

The bufflehead or "butter-ball," one of the smallest ducks, is a fairly common migrant in the Mississippi Valley and, although reported but a few times from Arkansas, doubtless occurs there quite regularly. At Helena, Mrs. Stephenson reports it on the authority of a local hunter. Dr. D. A. Richardson noted it as a rare migrant at Osceola in 1886, and it is reported by local hunters at Paragould as fairly plentiful in Mississippi County. C. E. Brewster killed one and saw a number that had been killed on Big Lake in November, 1909, but they are said to be rare there.

**Buddy Duck.** *Erismatura jamaicensis.*

The little ruddy duck, sometimes called "bristle-tail" or "booby," occurs in the Mississippi Valley as a common migrant and less frequently as a winter resident from Illinois southward. The only records from Arkansas are furnished by McAtee, who found it common at Turrell November 17, and saw several on Menasha Lake November 21, 1910.

**Snow Goose.** *Chen hyperboreus hyperboreus.***Greater Snow Goose.** *Chen hyperboreus nivalis.*

Snow geese, undoubtedly representing both forms of the species, occur regularly in migration in the Mississippi Valley, where they are almost universally known as "brant" or "white brant." They were seen at Helena, October 19–November 21, 1895, by Mrs. Stephenson, at Fayetteville, March 20–31, 1883, by Prof. Harvey, and at Delight, March 28, 1911, by Mr. Savage, these being the only definite records from the State.

**[Blue Goose.** *Chen caerulescens.*

The range of this goose is imperfectly known, but since it occurs as a common migrant in Illinois and as an abundant winter resident on the coast of Louisiana, it will undoubtedly be found in Arkansas during migrations.]

**White-fronted Goose.** *Anser albifrons gambeli.*

The "speckle-belly" or "speckled brant," as this goose is often called, is a fairly common bird in the Mississippi Valley and probably occurs regularly in Arkansas in migration. The only record from the State is by Audubon, who states that "numbers [were] seen high on the Arkansas River."<sup>1</sup>

**Canada Goose.** *Branta canadensis canadensis.*

The wild goose is a common migrant and winter resident in the State and a few pairs remain to breed in the most secluded parts of the Sunken Lands. At Walker Lake on May 4, 1910, I saw a pair and was told that several pairs breed there each season. This is

<sup>1</sup> Birds of Amer., VI, p. 209, 1843.

probably the extreme southern limit of this bird's breeding range in the Mississippi Valley, its principal summer home being in the interior of Canada. Migrating geese begin to arrive by the last of September (earliest seen at Helena, September 26) and are present in varying numbers until late March or early April.

Audubon found wild geese abundant on the Arkansas River in winter<sup>1</sup> and Hollister records their occurrence on the Grand Prairie about Stuttgart at the same season. McAtee found them abundant at Menasha Lake November 22-24, and C. E. Brewster saw several bunches, numbering about 75 in all, at Turrell December 20, 1910. The species has been reported in migration from Osceola, Little River, Monticello, and Fayetteville.

The food of the wild goose includes a variety of wild plants, such as grass wrack (*Zostera*), wild rice, arrowhead, sedges, and marsh grasses. Sprouting grain, including wheat, corn, barley, and oats, is a favorite food and the birds sometimes cause much damage by destroying the roots of grain. They frequently eat wild berries, as well as insects, crustaceans, small clams, and snails.

**Hutchins Goose.** *Branta canadensis hutchinsi*.

This small form of the wild goose is probably a fairly common migrant and winter resident. The only record at hand is that by Hollister, who saw two birds at Stuttgart in 1899.<sup>2</sup>

A goose weighing only about 3 pounds, shot at Mud Lake, St. Francis County, early in November, 1910, was probably of this subspecies.

**[Whistling Swan.** *Olor columbianus*.

This species is a rare migrant in the Mississippi Valley, and is found locally in winter from Illinois to Louisiana and Texas. It doubtless occurs occasionally in Arkansas.]

**Trumpeter Swan.** *Olor buccinator*.

The trumpeter swan is the species usually found in the Mississippi Valley in migration. Audubon reported it as visiting the Arkansas River annually, and he shot a specimen on a lake near the mouth of that river.<sup>3</sup> Large flocks of swans, probably of this species, were seen flying north at Helena, April 29, 1890, and April 20, 1891 (Stephenson). The bird is occasionally seen at Mud Lake, but in recent years has become very rare in the State.

**Wood Ibis.** *Mycteria americana*.

This large, storklike bird, often called "gourdhead," is a regular summer visitant in many parts of the State. It apparently does not nest in Arkansas, but wanders northward in July or August from its breeding grounds in the Gulf States. On July 7, 1910, I saw six in

<sup>1</sup> Birds of Amer., VI, p. 178, 1843.

<sup>2</sup> Wilson Bull., IX, p. 12, 1902.

<sup>3</sup> Orn. Blog., IV, pp. 537-538, 1838.

an open, swampy tract of woodland near Camden. When approached they rose leisurely and circled slowly over the tops of the trees for several minutes, but at the discharge of a gun sailed away into the thicker timber.

This species is reported to appear regularly in August at Turrell, and Mrs. Stephenson states that great numbers are seen in the fall at Helena, "drilling high in air." Mr. S. C. Dowell, of Walnut Ridge, has a mounted specimen which was killed in that vicinity. Oberholser, in 1902, reported the species as occurring abundantly in July and August along Red River north of Texarkana.

**Bittern.** *Botaurus lentiginosus*.

The bittern, "stake-driver," or "thunder-pump," is a common migrant in Arkansas and may occasionally breed there, though its normal summer home is from Missouri northward. The first spring migrant was noted at Fayetteville March 31 (Harvey, 1883) and at Delight April 11 (Savage, 1911). The species was common on the St. Francis River, north of Bertig, between April 25 and 30 (1909). It was reported as a summer resident at Newport in 1895. In autumn it has been recorded as arriving at Delight September 15 and 16 (Savage) and at Crocketts Bluff October 22.<sup>1</sup> Bitterns frequent marshes and the borders of streams, where their curious pumping notes may be heard and where they are often flushed and wantonly killed by duck hunters. Their food consists largely of frogs, snakes, lizards, crawfish, meadow mice, and fish.

**[Least Bittern.** *Ixobrychus exilis*.

This diminutive member of the heron family is a locally abundant summer resident throughout the Mississippi Valley, and will doubtless be found as a breeder in the swamps of Arkansas.]

**Great Blue Heron.** *Ardea herodias*.

This fine bird, often called "blue crane," is a fairly common summer resident and a few remain during the winter. It has been observed in the breeding season at Clinton, Walker Lake, Turrell, and Wilmot, and in fall and winter at Fayetteville, Fort Smith, Mud Lake, and Menasha Lake. It is most common in the bottomlands of the eastern part of the State, and at Walker Lake there is a large rookery containing several hundred nesting pairs. I visited this colony on May 4 and 5, 1910, and found the birds in the midst of their breeding season. The nests were concentrated in an area of a few acres in the middle of a big cypress swamp in which the water was at that time from 3 to 5 feet deep. They were placed near the tops of the larger trees, usually at a point where several limbs forked, and single trees contained from 1 to 10 nests. A few nests at this date contained eggs, but the great majority were occupied by young

<sup>1</sup> Forest and Stream, XIX, p. 286, 1882.



FIG. 1.—CYPRESS SWAMP, WALKER LAKE, ARKANSAS. SITE OF A LARGE HERON ROOKERY.



FIG. 2.—GREAT BLUE HERONS AND NESTS, WALKER LAKE, ARKANSAS.



a few days old. The calls of the young sounded like the chattering of a flock of blackbirds.

The food of this heron consists chiefly of fish, with the addition of frogs, lizards, snakes, meadow mice, young rats, crustaceans, small birds, especially the smaller marsh-inhabiting species, and insects, particularly grasshoppers and aquatic beetles.

**American Egret.** *Herodias egretta.*

The large white egret, formerly an abundant breeding species in the swamps of Arkansas and other States in the Mississippi Valley, has been almost exterminated through the milliners' demand for its plumes. Twenty years ago a large colony of these birds nested in the "Peck Cypress" near Armored. In May, 1910, in the Walker Lake rookery in the same county, I saw only three or four pairs, and in June of the same year Mr. B. Widmann found 3 nests there and saw only 3 adult birds. One of the nests contained 1 egg, another 3 nearly fledged young, and on the third an adult bird was sitting. Extensive shooting of this species for its plumes has ceased because there are not enough birds left to make the business profitable. But to assure the safety of the remnant will necessitate the strict enforcement of the law protecting all nongame birds.

**Snowy Egret.** *Egretta candidissima.*

Like the other white herons, this exquisite little egret, although once abundant, has been practically exterminated by persistent hunting for its plumes. It formerly nested in the Mississippi Valley States as far north as southern Illinois, but in recent years has been driven out from all but the more inaccessible parts of Louisiana. In 1886 it was reported as arriving at Osceola April 3, and in 1889 a few were seen at Clinton July 4. In June and July, 1902, Oberholser saw a few along Red River north of Texarkana.

**[Louisiana Heron.** *Hydranassa tricolor ruficollis.*

This is a southern species, breeding along the Gulf coast and north to North Carolina. It has been recorded from Indiana and Missouri, but there is no definite record of its occurrence in Arkansas. Oberholser reported the species common along Red River north of Texarkana (Tex.) in June and July, 1902.]

**Little Blue Heron.** *Florida cærulea.*

Since this species is not a plume producer, it has held its own better than the egrets and is still common in the swamps of southeastern Arkansas. It formerly bred as far north as Missouri and southern Indiana, but now probably does not occur in the nesting season north of southern Arkansas. At Wilmot the last week in June it was very common and doubtless breeds in the big swamps in that vicinity. It formerly nested in a large cypress swamp near Cypress, Ashley County, but the colony deserted that location some

years ago and occupied a nesting site near Jones, La. I saw one bird at Camden July 7, and Savage reports one seen at Delight August 16. After the breeding season many of these herons wander northward and some have been found as far north as Nebraska and Wisconsin.

This species presents three phases of plumage, independent of age or sex—a pure white phase, a blue phase, and a mottled or intermediate phase. Individuals of any of the phases may be found mated and breeding with those of another color. At Wilmot, in June, I found the three phases about equally represented.

The food of this heron consists chiefly of fish, frogs, lizards, crawfish, small crabs, and insects. The rice growers of southern Texas consider it very useful on account of its fondness for crawfish, which cause trouble in the rice fields by their depredations upon the crop and by burrowing into the embankments surrounding the fields. The stomachs of 4 specimens killed near Wilmot in June contained crawfish and aquatic beetles. One bird had eaten 35 of the crustaceans and 28 beetle larvæ.

**Green Heron.** *Butorides virescens.*

This familiar bird, known to many by the curious name of "Indian hen," is a common and generally distributed summer resident, most numerous, however, about the ponds and swamps of the eastern part of the State. Migrants arrive from the south about the first of April and most of them depart in October, though occasionally a few winter even as far north as Fayetteville. At Mammoth Spring, in June, green herons were numerous along Spring River, and at Wilmot the same month they were abundant about the shores of the lake close to town. Partly incubated eggs were found at the latter place June 25 and at the same time well-grown young were abroad. This heron feeds chiefly upon crawfish, insects, frogs, and small fish.

**Black-crowned Night Heron.** *Nycticorax nycticorax nævius.*

The common night heron is apparently a rather scarce and local summer resident from April to November, found chiefly in the swamps and along the larger rivers. It was reported as breeding at Newport in 1885, and in 1902 Oberholser observed it in numbers near Texarkana (Texas) in late June. McAtee saw one bird at Turrell on November 19, and found the species numerous at Big Lake June 20 to 23, 1911. This species feeds upon fish, crabs, lizards, mice, and insects.

**Yellow-crowned Night Heron.** *Nyctanassa violacea.*

This species formerly occurred as a breeder in the Mississippi Valley States as far north as southern Illinois and Indiana, but in recent years the birds have been largely driven out of the northern

part of their range. At Wilmot, the last week in June (1910), I shot two immature specimens which were probably reared not far away. Three records of casual occurrence are at hand—the first, a specimen (No. 9482, U. S. Nat. Mus.) collected at Fort Smith on the Whipple Expedition in 1853–54;<sup>1</sup> another, a mounted specimen in the possession of Mr. S. C. Dowell, of Walnut Ridge, which was killed on Swan Pond, near that town, about the year 1900; and a third, killed at Stuttgart, April 25, 1906, by Mr. J. L. Felger.

**Whooping Crane.** *Grus americana.*

The big white crane was formerly quite common in migration through the Mississippi Valley, but is now very scarce. Only one definite record of its occurrence in Arkansas has been found. Mr. D. B. Wier, writing under the nom de plume of "Byrne," records one of these birds seen near Crocketts Bluff on November 5, 1882.<sup>2</sup>

**Sandhill Crane.** *Grus mexicana.*

Like the previous species, the sandhill crane was once a common migrant in Arkansas, but is now scarce. Mr. D. B. Wier, writing from Crocketts Bluff in 1881, speaks of these cranes as found on the prairies near that place in February.<sup>3</sup> In 1884, Mr. W. A. Monroe recorded them on March 19 and 24 at Newport, and at Delight, in 1911, Mr. W. G. Savage saw a flock of 20 on March 12 and another flock April 4.

**King Rail.** *Rallus elegans.*

This species, the largest of the rails, is given by Widmann as "a fairly common summer resident in the marshes along the larger rivers" in Missouri, and the same author states that it is reported by Philo W. Smith, jr., of Eureka Springs, Ark., as a rare breeder in the White River Valley near that town.<sup>4</sup> It undoubtedly occurs frequently in migration, though no records are at hand. It may be looked for in the spring in March and April and in the fall in October and November.

**Virginia Rail.** *Rallus virginianus.*

The Virginia rail is probably fairly common in migration both spring and fall. Its breeding range is from Missouri northward. The only record from Arkansas is that of Hollister, who saw one bird at Stuttgart in January, 1899.<sup>5</sup> Like the other rails, it is an inhabitant of marshes and is very retiring in its habits.

<sup>1</sup> Kennerly, Whipple's Report Route near 35th Parallel, pt. 6, in Rept. Expl. and Surv. R. R. Pac., X, p. 33, 1860.

<sup>2</sup> Forest and Stream, XIX, p. 306, 1882.

<sup>3</sup> "Byrne," Forest and Stream, XVII, p. 430, 1881.

<sup>4</sup> Birds of Missouri, pp. 58, 59, 1907.

<sup>5</sup> Wilson Bull., IX, p. 12, 1902.

**Sora Rail.** *Porzana carolina.*

The sora is probably a common migrant in all parts of the State, passing north in April and May and returning in September and October. In migration it may often be found in very small or partly dry marshes and even in moist upland meadows. One was seen by Mr. C. E. Pleas September 18, 1896, on Pinnacle Mountain, 800 feet above Clinton.<sup>1</sup> At Mena, May 24, 1910, I flushed three from a wet meadow overgrown with briars. In spite of the very late date, I consider these birds migrants, but since the species has been found breeding near Kansas City, Mo., it may perhaps breed in the higher parts of Arkansas.

**Yellow Rail.** *Coturnicops noveboracensis.*

The yellow rail is a rather uncommon migrant in the marshes of the Mississippi Valley and may be looked for in Arkansas in March and April and also in autumn.

The only record for the State is furnished by a specimen in the United States National Museum (No. 12641) labeled "Fort Wayne, Ark., Lieut. Eustis." This fort was located on the Arkansas-Oklahoma boundary, about 10 miles south of the Missouri line, on one of the branches of Spavina Creek.<sup>2</sup>

**[Purple Gallinule.** *Ionornis martinica.*

This gallinule is a common resident of the Gulf States and tropical America, and occasionally wanders into the Middle States. Audubon speaks of it as occurring rarely as far north as Memphis,<sup>3</sup> so it will probably be found in Arkansas.]

**[Florida Gallinule.** *Gallinula galeata.*

This species occurs locally as a summer resident over a large part of the United States, and will undoubtedly be found breeding in some of the swamps of Arkansas.]

**Coot.** *Fulica americana.*

This species, which is often known as "mud hen," is a common migrant in the Mississippi Valley and doubtless occurs regularly in the swamps and lakes of Arkansas, breeding locally in small numbers. Widmann, in *Birds of Missouri*, records it on the authority of Philo W. Smith, jr., as breeding on White River, near Eureka Springs. About half a dozen were seen at Big Lake June 20, 1911 (McAtee). A writer in the *American Field* speaks of the arrival of coots in numbers in Crawford County in November.<sup>4</sup> McAtee found them abundant on Wappanocka and Menasha Lakes November 17-23, and saw a good many on Mud Lake November 14. The coot is mainly a vegetable

<sup>1</sup> Osprey, I, p. 67, 1897.

<sup>2</sup> See Keeler's Map of the U. S. Territories, Pacific R. R. Routes, Mineral Lands, and Indian Reservations, 1867.

<sup>3</sup> Orn. Blog., IV, p. 38, 1838.

<sup>4</sup> Bowden, Geo. W. C., *Amer. Field*, LVII, pp. 166, 167, 1902.

feeder, living upon a variety of aquatic plants and seeds. It is said to be especially fond of wild celery, and when feeding upon that plant its flesh takes on a delicate flavor and is considered by many equal to that of most ducks.

**Avocet.** *Recurvirostra americana.*

This is a bird of the plains, breeding from northern Texas to Alberta. Since it has several times been observed in Missouri, it probably visits Arkansas occasionally in migration. Cabot records a specimen taken in the State, donated to the Boston Society of Natural History by Maj. Townsend.<sup>1</sup>

**Woodcock.** *Philohela minor.*

The woodcock is still fairly common in Arkansas, occurring in both winter and summer. It is recorded as breeding at Fayetteville, where one was seen carrying its young, April 1, 1882,<sup>2</sup> and at Clinton and Newport (rare). Hollister reports it common in January and November at Stuttgart and Harvey says it occurs at Fayetteville during open winters. This fine game bird is rapidly diminishing in numbers over a large part of its range. Unfortunately, it is not protected by the laws of Arkansas and may be shot at any time. Under such conditions its early extermination in the State seems assured.

**Wilson Snipe.** *Gallinago delicata.*

This popular game bird, known usually as "jack snipe," is a common migrant and winter resident. The first fall migrants arrive from the north in September, and the birds become plentiful during October. They are usually common throughout the winter in the lower parts of the State, as on the Grand Prairie around Stuttgart, where Hollister found them numerous in January, and at Van Buren, where Hanna took one and saw a number of others December 29. Harvey reports them as occurring in open winters at Fayetteville,<sup>3</sup> and a writer in the American Field speaks of their occurrence in December near Alma, Crawford County.<sup>4</sup> In spring most of them pass north between the middle of March and the middle of April. As this species is afforded no protection by the laws of Arkansas, its numbers are decreasing year by year.

**[Long-billed Dowitcher.** *Macrorhamphus griseus scelopaceus.*

Dowitchers, often called red-breasted snipe, were formerly common in migration throughout the Mississippi Valley, but like most of the shore birds they have in recent years become rare. This species undoubtedly occurred formerly and perhaps still occurs in Arkansas.]

<sup>1</sup> Proc. Boston Soc. Nat. Hist., II, p. 250, 1847.

<sup>2</sup> Harvey, Amer. Nat., XVI, p. 737, 1882.

<sup>3</sup> Am. Nat., XVII, p. 737, 1882.

<sup>4</sup> "Old-Timer," Am. Field, LII, p. 131, 1890.

**Pectoral Sandpiper.** *Pisobia maculata.*

This species nests in the Arctic regions and passes the winter in South America. It is one of the commonest of the migrating sandpipers and should be found along the shores of the rivers, lakes, and ponds of Arkansas during March, April, and May, and on its return journey from the middle of July to the last of November. Apparently these sandpipers have not attracted the attention of the bird students of the State, for there seems to be no record of their occurrence, except one which I made on May 15, 1910, at Arkansas City, when I observed a pair of the birds feeding in a little pool of muddy water close to the Mississippi River.

**[White-rumped Sandpiper.** *Pisobia fuscicollis.*

This medium-sized sandpiper has frequently been taken in Missouri and probably occurs regularly in Arkansas in its migrations in May and September.]

**[Baird Sandpiper.** *Pisobia bairdi.*

This species is a not uncommon migrant in the Mississippi Valley, passing northward from early March to the middle of May and southward from August to October. It doubtless occurs regularly in Arkansas.]

**Least Sandpiper.** *Pisobia minutilla.*

As its name indicates, this is one of the smallest of sandpipers and it is also one of the commonest. Usually it occurs in flocks of a dozen or more individuals which frequent shallow ponds and mud flats along streams, often in company with other species of shore birds. Breeding in the far north, this bird migrates south in early summer and may be found in Arkansas from July to October. It passes the winter chiefly south of the United States and returns during May and early June. Preble saw three of these sandpipers and collected one at Fort Smith September 20, 1892.

**[Semipalmated Sandpiper.** *Ereunetes pusillus.*

This little bird, scarcely larger than the least sandpiper, occurs commonly in migration with other small species of shorebirds. It passes northward in late April and early May and southward from July to October, at which times it will undoubtedly be found regularly in Arkansas.]

**Greater Yellowlegs.** *Totanus melanoleucus.*

The "big yellowlegs," or "winter yellowlegs," as it is frequently called, is fairly common in the Mississippi Valley during migrations. It breeds in Canada and Alaska and spends the winter from the Gulf coast to southern South America. Its northward migration occurs in April and May and its southward movement from July till November. Audubon speaks of it as quite abundant in spring and fall on the Arkansas River,<sup>1</sup> but in recent years it has become relatively scarce. One was seen at Monticello April 13, 1909, by Miss Cavanaugh.

<sup>1</sup> Birds of Amer., V, p. 316, 1842.

**Yellowlegs.** *Totanus flavipes.*

This snipe is a common migrant in the Mississippi Valley both spring and fall, occurring often in large flocks. The birds pass north on the way to their summer home on the Barren Grounds during April and May, and return southward in July, August, and September. A few remain in the United States as late as November or on the Gulf coast even through the winter, but the majority pass on to South America. Only two records from Arkansas are at hand. One bird was seen at Monticello April 13, 1909, by Miss Cavaness, and one at Stuttgart May 14, 1910, by myself.

**Solitary Sandpiper.** *Helodromas solitarius.*

The solitary sandpiper occurs commonly in spring and fall, never assembling in large flocks, but found singly or a few together around the borders of lakes and streams or even small pools in the timber. The first migrants arrive usually by the middle of April and about May 1 the birds are numerous, some remaining until the middle of that month. Very little is known about the breeding of this species, but its range in summer is chiefly north of the United States. In fall it returns during July, August, and September, and a few may remain until late October before passing on to their winter home in South America. It has been observed at Lake City (April 30), Blytheville (May 3), and Delight (May 5, August 25).

**Western Willet.** *Catoptrophorus semipalmatus inornatus.*

This large snipe, or "tattler," breeds on the coast of Texas and Louisiana and from northern Iowa northward and westward, and winters on the Gulf coast and in Mexico. It is considered rare in Missouri (Widmann), and the only record from Arkansas is one furnished by Dr. D. A. Richardson, who reported a small flock seen at Osceola March 29, 1886.

**Upland Plover.** *Bartremia longicauda.*

This famous game bird—the "papabotte" of the Southern States—was formerly very abundant in migration on the prairies of the Mississippi Valley, but the terrible slaughter to which it is subjected every spring, especially in Louisiana and Texas, has greatly diminished its numbers.

The species still occurs in moderate numbers on its northward passage during March and April and again as it moves south in July, August, and September. It breeds from Oklahoma and Missouri northward to Alaska. Mrs. Stephenson records this bird as a rare migrant at Helena, and Mr. Savage reports one seen at Delight August 31, these being the only records from the State. The upland plover is mainly insectivorous in its diet and is especially fond of weevils, grasshoppers, beetles, and crickets. During migration it

frequently visits cotton fields, and it has been known to destroy the boll weevil.

[**Buff-breasted Sandpiper.** *Tryngites subruficollis*.

The main migration route of this species is through the Mississippi Valley. It has frequently been observed in Texas (April and August) and may be expected to occur in Arkansas.]

**Spotted Sandpiper.** *Actitis macularia*.

The spotted sandpiper, or "tip-up," is one of the most widely distributed and best known of the shorebirds, and is a fairly common summer resident in the State. Arriving from the south in early April and departing in October, it feeds chiefly along the shores of rivers, creeks, and lakes, and nests in near-by fields. It has been noted in the breeding season at Lake City, Helena, Womble, and Clinton.

The food of this species consists largely of insects, including beetles, flies, grasshoppers, and may flies. It takes some crawfish and many aquatic insects, and has been known to visit gardens for cutworms and other pests.

**Long-billed Curlew.** *Numenius americanus*.

The "sickle-bill" is the largest of the North American shorebirds and was formerly a common migrant in the Mississippi Valley, breeding from Oklahoma north to southern Canada. It is now comparatively scarce, except on the western plains. It has been occasionally seen in western Missouri (Appleton City, April 3, 1906; Jasper County, October 15, 1905),<sup>1</sup> and so may be expected to occur in western Arkansas. Audubon speaks of taking a specimen of this bird in Arkansas—the only record from the State.<sup>2</sup>

**Eskimo Curlew.** *Numenius borealis*.

This curlew was formerly a common spring migrant in the Mississippi Valley, but within the last 15 years has become nearly or quite extinct. The spring flight appeared usually in Texas in March and reached the latitude of Kansas by the middle of April. In the fall the birds passed south along the Atlantic coast, reaching their winter home in Argentina chiefly by a flight over the ocean.<sup>3</sup> The only record of the occurrence of this bird in Arkansas is furnished by Prof. Harvey, who noted its arrival at Fayetteville March 31, 1883.

**Black-bellied Plover.** *Squatarola squatarola*.

The black-breasted plover, or beetlehead, is a rare or irregular transient visitant. Its northward movement is in March and April and its southward flight from August to the end of October. Two specimens were taken by Preble at Fort Smith September 19, 1892—the only record from the State.

<sup>1</sup> Widmann, Birds of Missouri, p. 75, 1907.

<sup>2</sup> Cooke, W. W., Bull. 35, Biol. Surv., pp. 74-75, 1902.

<sup>3</sup> Orn. Blog., III, p. 240, 1835.

**Golden Plover.** *Charadrius dominicus.*

The golden plover was formerly a very abundant spring migrant in the Mississippi Valley during March and April, but in recent years its numbers have been greatly reduced by constant persecution, so that now it is infrequently seen. In the fall most of these plovers migrated south from their breeding grounds on the Arctic tundras to their winter home on the pampas of Argentina, by a long flight over the Atlantic Ocean.<sup>1</sup> A few, however, passed south through the Mississippi Valley. They were reported plentiful at Fayetteville March 20 to 31, 1883 (Harvey), and a small flight was seen near Crocketts Bluff October 22, 1882.<sup>2</sup>

**Killdeer.** *Oxyechus vociferus.*

The killdeer was formerly a common summer resident over most of the United States, but now is rare in many sections. It was reported as breeding at Clinton in 1889, but none were observed anywhere in the State during my 1910 trip (May-July). It still occurs frequently in migrations and is recorded as common in winter (November to January) on the Grand Prairie about Stuttgart (Hollister) and at Van Buren (Hanna). The first arrivals were noted at Fayetteville March 1 (Harvey, 1883). Two were seen at Delight, November 7 (Savage), and a few at Mud Lake, November 13, and at Turrell, November 17-19 (McAtee).

**[Semipalmated Plover.** *Ægialitis semipalmata.*

This little plover, often known as the "ringneck," is a common migrant in the Mississippi Valley, occurring chiefly in April and May, and again in July, August, and September. It will probably be found as a regular transient in Arkansas.]

**[Piping Plover.** *Ægialitis meloda.*

The piping plover is an uncommon migrant in the Mississippi Valley, occurring in Missouri in May, August, and September (Widmann). It may be looked for during the same months in Arkansas.]

**Buddy Turnstone.** *Arenaria interpres morinella.*

The turnstone nests in the Arctic regions and winters from the Gulf coast southward. It is known as a rather uncommon transient visitant in the Mississippi Valley during August and September and less frequently in spring. It was reported by Dr. Richardson in 1886 as a "rare migrant" at Osceola, the only record from the State.

**Bobwhite.** *Colinus virginianus.*

The bobwhite or quail is generally distributed in the State, and may be found in all cleared sections from the Mississippi bottoms to the tops of the highest mountains. It was formerly abundant

<sup>1</sup> Cooke, W. W., Bull. 35, Biol. Surv., pp. 80-85, 1910.

<sup>2</sup> "Byrne" [D. B. Wier], Forest and Stream, XIX, p. 286, 1882.

nearly everywhere, but is now scarce in many localities, particularly near the larger cities. If protected under a properly enforced game law it should remain indefinitely one of the important assets of the State. Gunners of wide experience assert that the quail of Arkansas are noticeably smaller in bulk than those living in the Northern States, but the differences, if any, are too intangible to warrant their separation into a named race. The breeding season of this bird extends from May to September, so that in many instances probably two broods are raised. At Lake City, April 28, some of the birds were paired, and I flushed a male and female from a freshly made nest under an upturned furrow in a plowed field. On September 25 (1892), at Fayetteville, Preble noted young quails but a few days old. At Delight, Savage found fresh eggs on August 1 and saw young just able to fly on September 28.

The food of the bobwhite consists mainly of weed seed, which forms over half of its total food. Grain constitutes only about one-sixth of the total and most of this is waste grain taken from stubble fields. Fruit amounts to about 10 per cent of the total food, and insects to about 15 per cent.

**Ruffed Grouse.** *Bonasa umbellus.*

In early times the ruffed grouse, or "pheasant," as it is called in the South, was probably a common inhabitant of the Ozark region of northwestern Arkansas, but it is now completely exterminated in the State. As long ago as 1883 it was reported by Prof. Harvey to be "very scarce" in the region about Fayetteville, and this, so far as I can find, is the only positive record of the occurrence of the bird in Arkansas. It has become very scarce in Missouri also, but Widmann gives a record for Shannon County as recently as the winter of 1905-6.

**Prairie Chicken.** *Tympanuchus americanus.*

Prairie chickens were once locally common in the State, but with the increase of hunters in recent years their numbers have been greatly reduced and in many sections they have been exterminated. Prof. F. L. Harvey, writing in 1883, recorded them as "formerly plentiful but now rare" in the vicinity of Fayetteville. He stated also that they were "resident on the Grand Prairie of southeastern Arkansas, as well as on the prairies south of the Arkansas River."<sup>1</sup> In a list of birds furnished by Mr. W. A. Monroe in 1884 this species is given as a breeder near Newport. Hollister records it as abundant in 1899 on the Grand Prairie near Stuttgart, but says that none were seen there in 1900. Inquiries which I made at the same place in 1910 elicited only the indefinite information that a few could be found in the remoter parts of the region. This valuable bird is so near extinction in the State that only a protective law rigidly enforced for a long term of years can save it from complete extermination.

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<sup>1</sup> Letter on file in Biological Survey.

**Wild Turkey.** *Meleagris gallopavo silvestris.*

Wild turkeys were formerly abundant over the whole State. They are still fairly numerous in the wilder parts of the heavily timbered bottoms in the eastern counties, but they are practically exterminated in the Ozark region of the northwest and in the more thickly settled regions generally. They were reported as common at Fayetteville in 1883 (Harvey); at Clinton in 1890 (Pleas); at Stuttgart in 1899 and 1900 (Hollister); and on White River below Clarendon in 1906.<sup>1</sup> During my 1910 trip I learned that they are still found in moderate numbers in the timbered bottoms near Blytheville and Turrell. McAtee found them numerous at the latter place and at Mud Lake in November and heard that they are still plentiful along Pemiscot Bayou, below Big Lake. A few are reported on Rich Mountain, in Polk County, but in the hill country around Pettigrew, where they were formerly common, all have disappeared. Mrs. Stephenson reports them still numerous near Helena. If this fine game bird is to be saved as an asset of the State, the open season must be very much restricted and a bag limit established.

**Passenger Pigeon.** *Ectopistes migratorius.*

The wild pigeon, once enormously abundant over a large part of the eastern United States, is now practically if not wholly exterminated. It occurred in Arkansas as a migrant and winter resident. In 1883 Prof. Harvey reported it very plentiful in winter at Fayetteville, and in 1889 Pleas noted the arrival at Clinton on April 9 of three flocks, numbering in all 36 birds. Mr. L. R. Morphew mentions the occurrence of a small flock of pigeons near Hot Springs about 1892—the last ones seen in that vicinity.<sup>2</sup> The last stronghold of these birds seems to have been in the extreme northwest part of Arkansas. The last shipment received by one game dealer of St. Louis came from Siloam Springs, Benton County, about 1893,<sup>3</sup> and Mr. O. Widmann informs me that as late as 1902 another St. Louis dealer received 12 dozen pigeons from Rogers, in the same county.

**Mourning Dove.** *Zenaidura macroura carolinensis.*

The mourning dove is a common summer resident throughout the greater part of Arkansas, but is less common in the mountains than in the lowlands. In fall and winter most of the doves which nest in the mountainous parts of the State move down into the lowlands, where they are joined by others from the States to the north. They are common all winter on the Grand Prairie (Hollister) and in other favorable localities. Hanna saw a flock of 25 at Van Buren

<sup>1</sup> Bacon, W. J. Amer. Field, LXVII, p. 362, 1907.

<sup>2</sup> Forest and Stream, LXVIII, p. 536, 1907.

<sup>3</sup> Deane, Auk, XII, p. 296, 1896.

on December 17. Nesting begins in the spring early in April (eggs found at Helena April 7) and may continue throughout the summer until September. The food of this species consists mainly of weed seed, which forms about two-thirds of the total, and grain makes up the remainder. The grain eaten is almost entirely waste kernels gleaned from stubble fields. The bird is thus seen to be highly beneficial in its food habits and well worthy of protection by the farmer.

**Turkey Vulture.** *Cathartes aura septentrionalis*.

Turkey buzzards are generally distributed over the State and are equally common in mountains and lowlands. They remain throughout the winter even in the Ozark region (common at Fayetteville) and in some sections are even more abundant at that season than in summer, since their numbers are increased by many birds from the more northern States.

Nests may be found in hollow logs or stumps in secluded parts of the timbered bottoms or in caves or crevices in rocky bluffs. While exploring a steep bluff along White River at Cotter June 8, I came upon two young buzzards in a cave near the top of the bluff. They were about half grown and were covered with white down. They stood up and hissed at me as long as I remained in sight. As is well known, these birds feed exclusively on carrion, and in warm climates render an important service by removing offensive carcasses.

**Black Vulture.** *Catharista urubu*.

The black vulture, or carrion crow, is more southern in its distribution than the turkey buzzard and is not usually found much beyond the limits of the Lower Austral Zone. It is generally distributed in the lower parts of the State, though usually less abundant than the turkey buzzard, with which it often associates.

It remains all winter in some localities and was reported common in January at Crocketts Bluff, when about 100 were seen feeding on a dead horse.<sup>1</sup> I have observed it at Wilmot, Eldorado, Camden, Stuttgart, Arkansas City, and Walker Lake. Savage has noted it a few times at Delight during June, July, and August. In the Ozark region it occurs locally, having been reported as a common resident at Clinton (Pleas) and at Fayetteville (Harvey).

**Swallow-tailed Kite.** *Elanoides forficatus*.

This handsome and graceful hawk nests locally in the Mississippi Valley, but is nowhere very common and is growing scarcer every year. Widmann speaks of it as "a regular, though not numerous, summer resident" in the cottonfield region of southeastern Missouri, but I failed to find any there in 1909, nor did I observe the bird in

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<sup>1</sup> "Byrne" [D. B. Wier], *Forest and Stream*, XX, p. 45, 1883.

Arkansas in 1910. In 1884 it was reported to breed at Newport and in 1890 in Little River County, and doubtless at that time was fairly numerous in the lowlands of the State, nesting chiefly in the cypress swamps. At present this interesting and useful species must be extremely rare. Its food consists largely of snakes and other reptiles, beetles, grasshoppers, cotton worms, and small frogs.

**Mississippi Kite.** *Ictinia mississippiensis.*

This species occurs as a summer resident in the Mississippi Valley as far north as southern Illinois. Widmann considers it common in southeastern Missouri and, although it has been reported from Arkansas only a few times, it probably occurs locally in the eastern part of the State. Mr. S. C. Dowell, of Walnut Ridge, has in his possession a mounted specimen of this bird taken near that town. In 1884 the species was reported as breeding at Newport. This bird, like the swallow-tailed kite, subsists largely on insects, small snakes, and frogs.

**Marsh Hawk.** *Circus hudsonius.*

One of the best-known hawks in the United States, this species is easily recognized as it flies low over the fields and marshes, by the conspicuous white patch at the base of its long tail. It is a common migrant and winter resident and may occur rarely as a breeder. It was reported to breed at Newport in 1884, and was seen in migration at Fayetteville September 28 (1892). At Delight, Mr. Savage noted it frequently during the winter. Study of its food habits has shown it to be a beneficial species, feeding chiefly upon meadow mice and other small rodents, lizards, frogs, snakes, insects, and, to some extent, on small ground-dwelling birds. It occasionally preys upon dead and wounded ducks and other game birds left by hunters, but seldom chases birds on the wing.<sup>1</sup> Unfortunately it is not very suspicious, and thus often falls prey to the thoughtless sportsman, who shoots all hawks on sight on the theory that they kill chickens and game birds.

**Sharp-shinned Hawk.** *Accipiter velox.*

This little hawk is widely distributed in the United States, but is not usually common in Arkansas, although it may at times be plentiful in migration. It was reported as a rare breeder at Clinton in 1890, arriving from the south on April 6, and has been reported to breed also at Newport. Its fall migration is performed chiefly in September and October. Several were seen by Preble at Fort Smith September 15 to 23 and at Fayetteville September 24 to October 1; Savage noted the first in fall at Delight on September 22 and by October 20 they had become common. They remained

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<sup>1</sup> Fisher, A. K., Bull. 3, Div. Orn. and Mamm., pp. 26-28, 1893.

there during most of November and one was seen on February 2 (1911). This is one of the few hawks which can be classed as decidedly harmful, since its food consists largely of wild birds and young poultry, varied occasionally with mice, insects, or small reptiles.

**Cooper Hawk.** *Accipiter cooperi*.

The Cooper hawk resembles the sharpshin in general appearance, but is much larger. It is generally distributed in North America, and is not uncommon in Arkansas. Savage collected a specimen at Delight, September 25, 1910, and observed the species frequently in January. Hanna saw the bird twice in December in the hills near Van Buren. It occurs locally in summer, but the only record at that season is from Delight, where Savage collected a set of four eggs May 4, 1911. This bird is a swift and fearless hunter and is responsible for a good share of the damage to poultry attributed to the larger hawks. Its food consists almost entirely of wild birds and poultry, but occasionally it captures small mammals, reptiles, batrachians, and insects.

**Red-tailed Hawk.** *Buteo borealis*.

The redtail occurs as a rare breeder and a fairly common winter resident. It was reported to be a tolerably common summer resident at Newport in 1884 and at Clinton in 1890. One was seen at Fayetteville September 29, 1892 (Preble), and the species was reported common in winter in the vicinity of Stuttgart (Hollister) and Van Buren (Hanna). McAtee observed one each near Forrest City, Turrell, and Menasha Lake in November, 1910. This is one of the larger hawks and shares with several other species the name "hen hawk." Careful study of its food habits by the Biological Survey has shown that the bird does not merit the title, since mice and other injurious rodents constitute fully four-fifths of its food and poultry (including game birds) only one-tenth. So great is the prejudice against all large hawks, however, that they are subjected to constant persecution by farmers and hunters, with the result that this species, with others, in many sections has become very scarce.

**[Harlan Hawk.** *Buteo borealis harlani*.

This dark form of the red-tailed hawk is supposed to be an inhabitant of the lower Mississippi Valley, but its status as a recognizable subspecies is open to doubt. Hollister records it as fairly common in winter on the Grand Prairie around Stuttgart, where he shot typical specimens.<sup>1</sup>

**Red-shouldered Hawk.** *Buteo lineatus*.

The red-shouldered hawk is a resident of the swamps and river-bottom woods throughout the State, and in such situations its shrill cries may frequently be heard. I found it common almost everywhere in eastern Arkansas, but did not observe any in the moun-

<sup>1</sup> Wilson Bull., IX, p. 13, 1902.

tainous sections. It breeds at Lake City, Walker Lake, Turrell, McGehee, Camden, and Wilmot. Two adult specimens taken at Wilmot the last week in June were molting, and at the same time and place two fully grown young birds were secured. Preble found the species common at Fort Smith and saw a few at Fayetteville in September, 1892. Savage reports it uncommon at Delight in summer, and Hollister records it as "tolerably common" around Stuttgart in winter. This hawk is a most beneficial species, feeding chiefly on mice and other small mammals, snakes, frogs, insects, and very rarely on birds. Two of the hawks collected at Wilmot had been feeding on a chicken. In the stomachs of the other two there were beetles, caterpillars, a grasshopper, a spider, and a toad. Of 220 stomachs of this hawk examined in the Biological Survey, only two contained remains of poultry and only 13 remains of other birds, while 102 contained mice. In spite of these well-known facts, the hawks are relentlessly destroyed by farmers on the mistaken theory that they are inveterate chicken thieves.

**Broad-winged Hawk.** *Buteo platypterus.*

The broadwing occurs as a migrant and a locally common summer resident. In 1890 it was reported as a common breeder at Clinton, arriving from the south February 18. Mr. Savage noted one at Delight, Pike County, on March 21, 1910, and Mrs. Stephenson reports it as a summer resident at Helena. I did not observe the species in the State, but shot a young bird June 15 in Oregon County, Mo., about a mile from Mammoth Spring, Ark. Bendire speaks of this hawk as "eminently a bird of the larger forests, and seldom seen in the more open and cultivated country;" while Widmann says that in Missouri it "prefers undulating ground where wooded tracts, even of medium-sized trees, adjoin creek bottoms, wet meadows, and cultivated fields." The broadwing is one of the beneficial hawks, its food consisting largely of small mammals, reptiles, batrachians, and insects.

**[Golden Eagle.** *Aquila chrysaetos.*

The golden eagle is a common bird in the western United States and has frequently been taken in Missouri in winter. It probably occurs irregularly in Arkansas, and may possibly breed in the mountainous parts of the State.]

**Bald Eagle.** *Haliaeetus leucocephalus.*

This fine bird is a rather rare resident in the wilder sections of the State, chiefly in the big swamps of the eastern part. It was reported to be rare at Osceola in 1886, near Clinton in 1890, and near Helena in 1910. One was seen at Clinton on February 9, and Hollister reports a few in winter in the vicinity of Stuttgart (1899 and 1900). Mr. S. C. Dowell, of Walnut Ridge, has in his possession a mounted

specimen which was killed in Lawrence County. One was shot in January, 1896, from a fence in the town limits of Helena. It is known to breed rarely near that town and also in the big swamps west of Wilmot, where a specimen was killed in June, 1910, by Mr. E. M. McCormick.

This bird is seldom found far from lakes or streams, where it can obtain its favorite food. In addition to fish, which form more than half its food, it destroys many birds, chiefly water fowl, and considerable numbers of mammals, mainly the smaller kinds, and the young of larger species. Occasionally it attacks domestic animals, such as lambs and pigs. Oberholser, after treating exhaustively of its food habits, concluded that it "is rather more beneficial than otherwise."<sup>1</sup>

**Duck Hawk.** *Falco peregrinus anatum.*

This bold and attractive falcon, although never abundant, was in former years locally common in the Mississippi Valley, nesting usually about cliffs, but occasionally also in cavities in tall trees in the bottom lands. Widmann gives numerous records of its former occurrence in Missouri, but considers it now decidedly rare and probably only a migrant. The only record from Arkansas seems to be one published by Bendire on the authority of Mr. B. T. Gault, who reports the bird nesting in the spring of 1888 in the sandstone bluffs along the Little Red River in Cleburne County.<sup>2</sup> The duck hawk feeds almost exclusively on birds, and when living in the vicinity of settlements often does serious damage to poultry and pigeons.

**Pigeon Hawk.** *Falco columbarius.*

The pigeon hawk nests chiefly north of the United States, but is a rather common migrant and winter resident in the Southern States. In 1890 it was reported rare in the vicinity of Clinton, one being seen on January 20, another February 18. Hanna saw one in December, 1910, near Van Buren. There are no other records from the State, but the bird is doubtless of regular occurrence in fall and winter. The food of this little hawk consists chiefly of the smaller wild birds up to the size of a pigeon, with the addition of a few insects and small mammals. It almost never attacks full-grown poultry, but is sometimes quite destructive to young chickens.

**Sparrow Hawk.** *Falco sparverius.*

This handsome little hawk—the smallest of its tribe—is a fairly common resident, nesting in hollow trees about open fields. In winter it is perhaps even more common than in summer, for its numbers are at that season increased by migrating individuals from

<sup>1</sup> Bull. 27, Biol. Survey, p. 16, 1906.

<sup>2</sup> Life Hist. N. Am. Birds [I], p. 294, 1892.

the more northern States. The species has been reported as a common resident at Fayetteville, Fort Smith, Clinton, Newport, Osceola, and Helena. I saw it in summer at Armorel, Wilmot, and Camden, and Savage reports a few seen at Delight. In winter it is reported very common on the Grand Prairie around Stuttgart (Hollister) and near Van Buren (Hanna). It is a decidedly useful species, its food consisting during the summer almost exclusively of insects. It is especially fond of grasshoppers and, when these pests are abundant, selects them in preference to any other food. In winter its diet is varied with mice and other small mammals, lizards, snakes, and small birds.

**Osprey.** *Pandion haliaëtus carolinensis.*

The osprey, or fish hawk, was formerly a common summer resident along the larger rivers of the State, but of late years it has become very scarce. It was reported as breeding at Newport in 1884 and at Osceola in 1886. Mr. B. T. Gault saw it in May, 1888, on the upper White River, near the Missouri boundary,<sup>1</sup> and found it nesting in holes in the sandstone bluff along Little Red River, central Arkansas.<sup>2</sup> Preble saw one at Fort Smith September 19, 1892. I did not observe any during my 1910 trip. The food of this species, as indicated by its common name, consists wholly of fish. Even where it is abundant, however, as on the Atlantic coast, the toll it levies on fish is considered to be offset by its graceful appearance and interesting habits.

**Barn Owl.** *Aluco pratincola.*

The barn owl is a common resident of the lower Mississippi Valley and occurs rarely as far north as Missouri. It probably occurs generally in the lowlands of Arkansas, but not in the mountainous sections. Mr. H. S. Reynolds records the species at Judsonia, in the winter of 1876-77,<sup>3</sup> Mrs. Stephenson reports it as resident at Helena, and Mr. Savage took a specimen at Delight, June 1, 1911. This large owl is one of the strictly beneficial species, its food consisting almost exclusively of mice, rats, and other small mammals.

**Long-eared Owl.** *Asio wilsonianus.*

This owl breeds in Canada and the United States as far south as Arkansas and winters mainly in the United States and Mexico. It was reported as breeding at Newport in 1884 and "resident" at Clinton in 1890. Hollister records it common in winter near Stuttgart, and Savage took a specimen at Delight on November 17. It is apparently rare in most parts of the State. It is a bird of the deep woods and is rarely observed. This is another of the useful birds of

<sup>1</sup> Widmann, O., Birds of Missouri, p. 104, 1907.

<sup>2</sup> Bendire, Life Hist. N. Am. Birds [I], p. 323, 1892.

<sup>3</sup> Am. Nat., XI, p. 308, 1877.

prey which is persistently slaughtered at every opportunity under the mistaken notion that it kills chickens. Its food consists chiefly of mice and other small mammals, with a small percentage of wild birds.

**Short-eared Owl.** *Asio flammeus.*

The short-eared owl is almost cosmopolitan in its distribution, but is known to occur in the breeding season in the United States no farther south than Missouri. In winter it moves southward and is often found in flocks in various parts of the United States. It prefers more open country than most other owls, habitually seeking its food and building its nest on the prairies or marshes. Hollister recorded its presence in small numbers in winter on the Grand Prairie around Stuttgart, and it is doubtless generally distributed at that season over the prairie lands of the State.

**Barred Owl.** *Strix varia varia.*

The barred owl, or "hoot owl," as it is frequently called, is probably the most abundant member of its family in the State. A few may be found in nearly every large tract of river-bottom timber and it is particularly common in the heavy swamps of the eastern counties. It is a permanent resident wherever found. The range of the northern subspecies can not be defined, since no specimens of this form are available; but it probably occupies the mountainous regions in the northern and western parts of the State. Records of barred owls from Fayetteville and Chester are doubtless referable to the northern bird. This owl has been accused of visiting chicken roosts and carrying off young or half-grown fowls, but examination by the Biological Survey of over 100 stomachs of this species demonstrated that its food ordinarily consists chiefly of mice and other small mammals, insects, birds, crawfish, frogs, and fish. Only three of the stomachs examined contained poultry. Hence the barred owl is considered in the main a beneficial species and worthy of protection.

**Florida Barred Owl.** *Strix varia alleni.*

The southern form of the barred owl occurs in the southern half of Arkansas, as shown by specimens from Wilmot, Delight, and Van Buren, and its range very probably extends northward in the bottom lands of the Mississippi to the northern border of the State. Barred owls have been observed at Lake City, Walker Lake, Newport, and McGehee. Hollister records them common in winter at Stuttgart. At Wilmot, the last week in June, a number of these owls roosted every day in a patch of overflowed timber, and at dusk one evening I saw three fly out and sail leisurely down to a near-by slough, where they procured their food. In this slough, about 8 o'clock one morning, I shot a fully grown young one from the thick lower branches of an oak. Examination of this bird's stomach showed that it had eaten a crawfish and a cutworm.

**Saw-whet Owl.** *Cryptoglaux acadica*.

The saw-whet, the smallest owl found in the eastern United States, occurs commonly in the Northern States, but in the lower Mississippi Valley is a rare or accidental winter visitant. There is but one record from Louisiana and one from Arkansas, based on an entry in the catalogue of the United States National Museum of a specimen (No. 3891) collected at Fort Smith by the Whipple Expedition of 1853-54. The specimen itself can not now be found, and considerable doubt attaches to the correctness of the record, especially in view of the fact that Lieut. Whipple's party was at Fort Smith only a few days in the early part of July—a time of year when this owl would not be expected to occur so far south.

**Screech Owl.** *Otus asio asio*.

This familiar little owl is generally distributed in the State, but is more often heard than seen. It remains throughout the year, nesting in hollow trees or sometimes in bird boxes or cavities around farm buildings. No specimens of the northern form (*asio*) are known to have been taken in Arkansas, but it probably will be found in the higher parts of the State. Records of its occurrence at Fayetteville, Clinton, and Mammoth Spring are considered referable to this subspecies. In its food habits the screech owl is almost wholly beneficial, feeding largely on mice and insects and less frequently on small birds, lizards, frogs, and crawfish. With the increase of English sparrows this owl has acquired a fondness for these pests, and this fact, coupled with its habit of hunting mice around barnyards and grain stacks, should lead every farmer to protect it as far as possible.

**Florida Screech Owl.** *Otus asio floridanus*.

This southern form of the screech owl probably inhabits the southern and eastern parts of Arkansas. Several specimens, including both red and gray individuals, have been taken at Delight by Savage, and Hanna took one at Van Buren. Screech owls, doubtless of this subspecies, are reported fairly common at Wilmot, Stuttgart (Hollister), Helena, and Osceola.

**Great Horned Owl.** *Bubo virginianus*.

This owl, one of the largest and fiercest of its tribe, is generally distributed in the State, but in most sections is not very common. It was reported as a resident and breeder at Newport (1884) and Clinton (1890), and Preble killed one at Fayetteville, September 28, 1892. Savage reports it fairly common at Delight, and McAtee noted it at Turrell and Menasha Lake. I did not observe any during my 1910 trip. This species is notoriously destructive to poultry and game birds, but it also feeds extensively on mice, rats, rabbits, and other small mammals. It captures also a few small birds and some

insects. In thickly settled regions it may at times become a nuisance, but in the sparsely settled West it is one of the most useful birds of prey, feeding very largely upon rabbits and other destructive rodents.

**Snowy Owl.** *Nyctea nyctea*.

The snowy owl is a resident of the frozen North and visits the United States only in winter. There are numerous records from Missouri, but south of that State the species is a very rare straggler. The only record for Arkansas is one given by Audubon, who states that this owl occurs in winter on the Arkansas River.<sup>1</sup>

**Carolina Paroquet.** *Conuropsis carolinensis*.

This handsome and interesting bird—the only representative of its family in the eastern United States—was formerly common in the South Atlantic and Gulf States and the Mississippi Valley generally as far north as Iowa. At the present time it is restricted probably to Florida and even there is rare and local. Its extermination in the Mississippi Valley was practically accomplished about 20 or 25 years ago, although a few stragglers have been seen in Missouri and Kansas as recently as 1905.<sup>2</sup> Bendire records it as comparatively common in the Mississippi and White River Valleys in 1860, and mentions seeing large flocks throughout that year in the vicinity of Fort Smith.<sup>3</sup> Mr. B. T. Gault, writing in 1888, says: "At one time paroquets were very plentiful at Paroquet Bluff, between Newport and Batesville on the White River, but none have been seen there for at least eight years."<sup>4</sup>

Mr. O. P. Hay, in 1881, stated that paroquets had recently been seen in southeastern Arkansas,<sup>4</sup> and in 1885 Mr. W. A. Monroe reported them as summer residents at Newport.

The food of the paroquets consisted of a variety of wild seeds, nuts, fruits, and berries. They were fond also of cultivated fruit and were accused of damaging corn and other grain when in the milk. This habit, coupled with their confiding nature and their habit of flocking about wounded comrades, furnished the cause and the opportunity for their extermination by man.

**Yellow-billed Cuckoo.** *Coccyzus americanus*.

The yellowbill is the common species of cuckoo or "rain crow" in Arkansas, where it is generally distributed as a summer resident. The average date of its arrival at Helena is April 25 (earliest, April 19) and the last one at Delight in autumn was noted September 25. It has been observed also at Fayetteville, Clinton, Newport, Mammoth Spring, and other places. Cuckoos inhabit a variety of situations in both mountains and lowlands, choosing usually for their nesting site

<sup>1</sup> Orn. Blog., II, p. 135, 1834.

<sup>2</sup> Life History N. Am. Birds [II], p. 1, 1895.

<sup>3</sup> Widmann, O., Birds of Missouri, p. 116, 1907.

<sup>4</sup> Bull. Nutt. Orn. Club, VII, p. 93, 1882.

a thicket or low tree in some secluded spot. I found them unusually numerous at Wilmot the last week of June in cypress trees along the shore of a lake. This species is known to be exceedingly useful, feeding exclusively on insects and showing a decided preference for caterpillars, including the hairy kinds rejected by many birds. In the cotton fields of Texas I found it in large numbers, destroying great quantities of cotton-leaf worms (*Alabama argillacea*).

**Black-billed Cuckoo.** *Coccyzus erythrophthalmus*.

The black-billed cuckoo is much rarer than the yellow-billed and is known to breed in the State only in the Ozark region. The only records are those furnished by Widmann,<sup>1</sup> who says: "In the Ozarks it is reported as a breeder as far south as Heburn [= Heber], Cleburne Co., Ark., by Mr. B. T. Gault in 1888, and at Eureka Springs by Mr. Philo W. Smith, Jr., in 1906." This cuckoo is essentially similar in its habits to the more common species, and like it deserves the fullest protection.

**Belted Kingfisher.** *Ceryle alcyon*.

The kingfisher is found in moderate numbers on practically all the streams, lakes, and ponds of Arkansas, but is most numerous in the well-watered sections in the eastern part. It is a hardy bird, many individuals remaining throughout the winter in the warmer parts. It has been observed in summer at Mammoth Spring, Clinton, Pea Ridge, Wilmot, Womble, and other places, and has been recorded in winter at Helena, Van Buren, and Judsonia;<sup>2</sup> Mud Lake, November 13; and Turrell, November 19. The food of this bird consists almost exclusively of fish, the larger part of which is of species of little value to man. When fish are difficult to obtain, it occasionally has recourse to other food, such as crawfish, insects, and even vegetable matter, as the berries of the sour gum.<sup>3</sup>

**Ivory-billed Woodpecker.** *Campephilus principalis*.

This noble bird, the largest of its family in the United States, was formerly common in the heavy swamps of the Mississippi Valley as well as the Southeastern States generally. Through constant persecution its numbers have been greatly reduced everywhere and it has been exterminated over a large part of its range. A few are believed to remain in the wilder parts of southeastern Arkansas. A writer in *Forest and Stream*, in 1885, states that in the region about Newport the ivorybill "may be found in unfrequented swamps," and adds: "It is not rare, but is rarely met with."<sup>4</sup> It was reported from Osceola in 1887 by Dr. Richardson, and Mrs. Stephenson says that in 1910 the ivorybill is "reported by fairly reliable people" as still

<sup>1</sup> Birds of Missouri, p. 118, 1907.

<sup>2</sup> Bendire, Life Hist. N. Am. Birds [II], pp. 36-37, 1896.

<sup>3</sup> Reynolds, H. S., Amer. Nat., XI, p. 307, 1877. <sup>4</sup> "Yell," *Forest and Stream*, XXIV, p. 407, 1885.

occurring near Helena. Some persons do not distinguish this species from the pileated woodpecker, with which it shares the names of "logcock," "woodcock," "woodchuck," etc. It has been ruthlessly destroyed by hunters for mere sport or for the sake of its brilliant scalp or its polished white bill. Never widely distributed, this useful and interesting bird has become yearly more restricted in its range, until now it is on the verge of extinction.

**Hairy Woodpecker.** *Dryobates villosus villosus*.

The hairy woodpecker is generally distributed throughout the State in both summer and winter, but is nowhere very common. The northern form (*villosus*) has been found breeding at Mammoth Spring and at Clinton. One specimen was taken at Van Buren December 7. The range of this subspecies within the State can not be exactly defined, but it doubtless occupies only the Ozark region and its foothills. Its food habits are similar to those of its smaller relative, the downy woodpecker, and like it the hairy is considered decidedly useful.

**Southern Hairy Woodpecker.** *Dryobates villosus auduboni*.

This subspecies, a somewhat smaller bird than the northern form, probably occupies the southern half of the State and the Mississippi bottoms. A specimen was taken at Armorel, Mississippi County (May 5), and the bird was observed in small numbers at Turrell, Wilmot, Camden, Delight, and Rich Mountain.

**Southern Downy Woodpecker.** *Dryobates pubescens pubescens*.

The little downy woodpecker is common in all parts of the State and is equally at home in the deep swamps and on the dry rocky slopes of the mountains. It is nonmigratory and nests throughout its range. Specimens were taken at Turrell, Wilmot, and Rich Mountain, and the species was observed at Mammoth Spring, Lake City, Eldorado, and Camden. Savage reports it fairly common at Delight. The downy is considered the most useful of all our woodpeckers. Stomach examinations made in the Biological Survey showed that three-fourths of its food is made up of insects, few of which are useful kinds. The balance of its diet consists of wild fruits, berries, and nuts.

**Downy Woodpecker.** *Dryobates pubescens medianus*.

The northern and slightly larger form of the downy woodpecker has been taken at only one locality in the State, Van Buren, where 6 specimens were secured by Mr. G. Dallas Hanna between November 29 and January 7. Whether these birds were migrants or representatives of the breeding form of the Ozark region can not be decided until breeding specimens are secured from that part of the State. Hollister has recorded *medianus* from Stuttgart in winter, but he took no specimens, and the southern form very probably occurs there also.

**Red-cockaded Woodpecker.** *Dryobates borealis.*

This southern woodpecker is of very local distribution in the State and seems to be confined to pine woods. It was reported as breeding rather commonly near Clinton in 1890 and a specimen from there was identified in the Biological Survey. Mr. W. A. Monroe, of Newport, found it breeding near there in 1884 and killed several specimens. Mr. B. T. Gault observed the birds daily in the summer of 1888 in pine woods at Heber, Cleburne County,<sup>1</sup> and Mr. Savage saw three individuals at Delight, October 14, 1910, although none had been observed there during the summer.

**Yellow-bellied Sapsucker.** *Sphyrapicus varius.*

The sapsucker is a northern-breeding species, found in the nesting season from the latitude of St. Louis northward and occurring in Arkansas as a spring and fall migrant and winter resident. It has been recorded in winter at Delight and Judsonia.<sup>2</sup> Hanna took 8 specimens at Van Buren between December 6 and 28, and doubtless it is common at that season over the greater part of the State. Spring migration takes place mainly in late March and early April, the first arrival at Clinton having been noted on April 7 and at Delight on April 5. The fall migration is chiefly during October, the first birds having been seen at Delight on the 15th and the species was common by the 20th. Its occurrence in summer has been reported by Mr. W. A. Monroe, who found a number of the birds in the hills 50 miles west of Newport in June, July, and August, 1884.<sup>3</sup> No nests or young birds were observed and the record, being unsubstantiated by specimens, is open to considerable question, since the species has never been found elsewhere in the Mississippi Valley so far south in summer. This is the only one of the woodpeckers of the State which is fairly entitled to be called a "sapsucker." It is known to do considerable damage to certain forest and orchard trees, including birch, maple, oak, ash, apple, and other species, by puncturing the bark in the form of girdles, sometimes causing the death of the trees. The birds feed both on the sap which flows from the punctures and on the insects attracted to the sap. Their food includes also large numbers of forest insects, as well as wild fruits and berries.

**Pileated Woodpecker.** *Phloxotomus pileatus.*

This large woodpecker, known under the vernacular names of "woodcock," "logcock," "woodchuck," etc., is quite common and generally distributed in the heavily timbered parts of the State. It is nonmigratory and breeds throughout its range, having been

<sup>1</sup> Widmann, O., *Birds of Missouri*, p. 121, 1907.

<sup>2</sup> Reynolds, H. S., *Am. Nat.*, XI, p. 308, 1877.

<sup>3</sup> Cooke, W. W., *Bull. 2, Div. Econ. Orn.*, p. 130, 1888.

reported from Clinton (where eggs ready to hatch were found on April 28), Newport, Helena, Mammoth Spring, Fayetteville, Stuttgart, Wilmot, and Delight. This bird is ordinarily rather shy, but many of the less experienced individuals fall victims to thoughtless gunners. Its food consists chiefly of forest insects (particularly the larvæ of wood-boring beetles) and some wild fruits.

**Red-headed Woodpecker.** *Melanerpes erythrocephalus.*

The redhead is an abundant resident in all parts of the State and especially favors cultivated lands containing much dead timber. Irregularly migratory in the northern parts of its range, it is found in Arkansas throughout the year, and is perhaps more abundant in winter than in summer. It has been observed at Fayetteville, Rich Mountain (at 2,600 feet), McGehee, Lake City, Mammoth Spring, and other places.

This woodpecker has been frequently accused of pulling up newly sprouted corn, and it has a decided taste for cultivated fruit and berries. On the other hand, stomach examinations have shown that corn forms only about 7 per cent of its total food and that about half of its food consists of insects, the larger part of which are beetles, ants, and grasshoppers. At Van Buren, where the bird was common in December, Hanna noticed its habit of storing acorns and other nuts in hollows in trees.

**Red-bellied Woodpecker.** *Centurus carolinus.*

Although less numerous than the redhead, this woodpecker is a fairly common resident in nearly all sections. It is reported common in winter at Stuttgart (Hollister), Van Buren (Hanna), and Fayetteville.<sup>1</sup> It has been observed also at Clinton, Lake City, Helena, Wilmot, Camden, and other places.

This species eats more vegetable matter than any other woodpecker, its diet including a variety of wild fruits and berries, besides many insects.

**Flicker.** *Colaptes auratus auratus.*

The flicker, or yellow hammer, is a fairly common resident in both winter and summer. Many migrants pass through in spring and fall, and many from farther north spend the winter in the State. The ranges of the northern and southern forms are not accurately known, but the typical race (*auratus*) will probably be found breeding in the southern and eastern parts of the State. The flicker has been reported as a summer resident at Newport, Helena, Wilmot, and Delight, but is not usually an abundant bird at this season. In its diet this species shows a special fondness for ants, which constitute nearly half of its food, and a single bird has been known to consume

<sup>1</sup> Cooke, W. W., Orn. and Ool., VIII, p. 34, 1883.

over 3,000 of these insects at a meal. In addition, flickers capture many beetles and other insects and take a large variety of wild fruits, berries, and seeds. Corn and other grains are only rarely eaten.

**Northern Flicker.** *Colaptes auratus luteus*.

The northern form of the flicker occurs as a breeder only in the mountainous parts, but in winter it may be found more or less frequently throughout the State. Breeding specimens were taken at Mammoth Spring, and the bird is reported in summer from Fayetteville and Clinton. In winter it is recorded as abundant at Stuttgart<sup>1</sup> (Hollister), and of frequent occurrence at Fayetteville and Clinton. Hanna found flickers common at Van Buren in December and took two specimens of this subspecies.

**Red-shafted Flicker.** *Colaptes cafer collaris*.

This is a western species breeding as far east as eastern Nebraska and western Texas. It occurs only casually in Arkansas, there being but one record—a typical specimen taken by Mr. G. Dallas Hanna at Van Buren, January 7, 1911. In habits this species closely resembles the eastern flicker.

**Chuck-will's-widow.** *Antrostomus carolinensis*.

This curious bird, resembling in appearance a large whippoorwill, is so retiring in its habits that it is rarely seen. It occurs commonly as a summer resident in many parts of the State, arriving from the South about the middle of April (Cerro Gordo, April 13, 1890; Helena, April 19, 1896), and departing in early fall. Although characteristic of the Lower Austral Zone, this species seems to be more abundant in the foothills than in the lowlands. It is reported as a summer resident at Newport and Helena, but I did not observe it in the lowlands. In the foothills near Delight it is common. On May 20, at dusk, the birds could be heard in every direction calling from the edges of the mixed upland timber. Three or four were heard on the lower slopes of Rich Mountain, where the upper limit of the bird was found to be about 1,800 feet. Although not seen in the higher parts of the Ozark region, it ranges up the valley of White River as far, at least, as Cotter. It was noted also at Mammoth Spring. Mr. C. E. Pleas, writing from Clinton, reports these birds abundant and says:

Their favorite retreat here is open, sterile, rocky ground bordering the hill-sides. \* \* \* Of a hundred or more which I have traced up in the moonlight, every one was perched on the ground, a rock, or a log, or occasionally on a low limb or snag when singing.<sup>2</sup>

<sup>1</sup> Possibly including also some of the southern form.

<sup>2</sup> Oologist, VII, p. 156, 1890.

The food of this species, according to Bendire, consists mainly of beetles, winged ants, and other insects, especially the night-flying Lepidoptera. Strange as it may seem, it occasionally captures and swallows small birds.

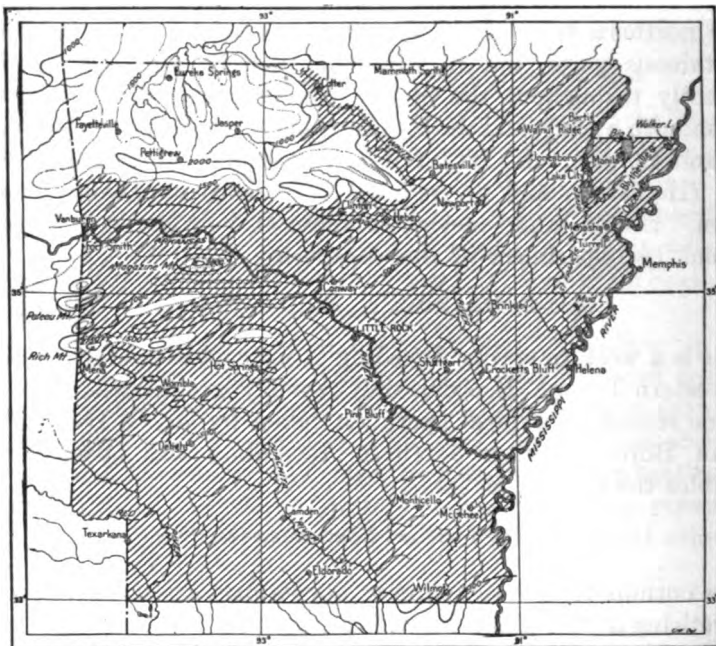


FIG. 1.—Breeding area of the chuck-will's-widow (*Antrostomus carolinensis*) in Arkansas.

**Whippoorwill. *Antrostomus vociferus*.**

The whippoorwill occurs as a summer resident in the more elevated portions of the Ozark region, where it often occupies the same localities as the chuck-will's-widow. It is recorded as abundant at Clinton, arriving there from the south March 31 and nesting in the rocky ravines of the mountains.<sup>1</sup> It is reported also as breeding at Pea Ridge, and I noted a few at Pettigrew about June 1, evidently on their breeding grounds. As a migrant it is reported from Helena, Newport, Monticello, and Delight, noted at the latter place March 31 and September 9 to 14. Like the preceding species, this bird is very retiring in its habits and is rarely seen, though its loud voice at night readily betrays its presence. The mistaken notion that this bird and the nighthawk are the same species is very prevalent. The whippoorwill is one of the most valuable of all our birds, being a great destroyer of moths, May beetles, caterpillars, and other harmful insects. It has been known to eat the potato beetle and also the Rocky Mountain locust.

<sup>1</sup> Peas, C. E., *Oologist*, VII, pp. 155, 156, 1890.



THE GOATSUCKERS OF ARKANSAS. NIGHTHAWK, WHIPPOORWILL, AND CHUCK-WILLS-WIDOW.



**Nighthawk.** *Chordeiles virginianus virginianus*.

The nighthawk, or "bullbat," occurs as a common migrant and a rare and local summer resident. It arrives from the south about the 20th of April, and migrating individuals are more or less common for a month or more. In the fall the southward movement begins late in August and continues through September, the birds being most abundant during the latter month. The species is reported to breed at Clinton, Pea Ridge, and near Newport. I observed it in small numbers at Mena (May 24), Pettigrew (June 1), and Mammoth Spring (June 15). A flock of 10 seen at Womble, May 22, may have

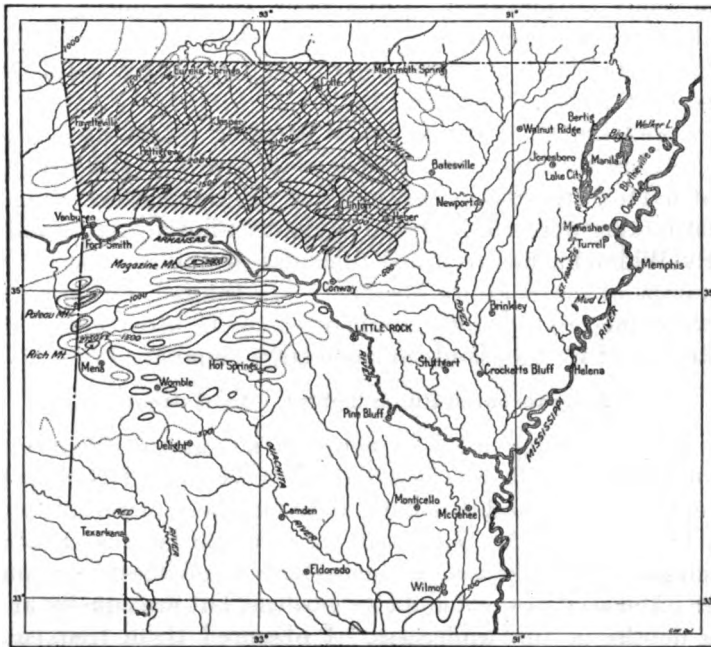


FIG. 2.—Breeding area of the whippoorwill (*Antrostomus vociferus*) in Arkansas.

been migrants. Preble found them common at Fort Smith on September 15 and noted them daily at Fayetteville from September 24 to October 1. Savage observed a few at Delight between August 26 and September 24. Nighthawks are strictly insectivorous and eminently beneficial. They are adepts at capturing insects on the wing, and their stomachs are often gorged with the fruits of their chase. Among other destructive species which they assist in keeping down is the cotton-boll weevil, a pest now rapidly spreading over Arkansas. Cotton growers in the State would do well to see that the law protecting this valuable bird is strictly enforced, more especially as in the fall many are shot by irresponsible boys and thoughtless hunters, to whom the temptation of a flying mark is irresistible.

**Florida Nighthawk.** *Chordeiles virginianus chapmani*.

The occurrence of this southern form of the nighthawk in Arkansas was unknown until I secured a typical specimen at Stuttgart, May 12, 1910. The subspecies probably breeds in favorable localities in the southern part of the State. It was observed in small numbers on the Grand Prairie around Stuttgart, and one was seen at Eldorado July 3.

**Chimney Swift.** *Chætura pelagica*.

This bird, commonly known as "chimney swallow," or "chimney sweep," is one of the most abundant species in the State and is found in practically all localities. From their winter home south of the United States the first ones arrive about the last of March (earliest at Helena, March 21; average, March 25) and remain until October (last seen at Helena, October 19).

As is well known, their ordinary breeding places are in unused chimneys, but in thinly settled districts a few may still retain their ancient habit of nesting in hollow trees. Pleas, in 1890, stated that such situations were used by the swifts at Clinton, Ark., and more recently Widmann has recorded their use of hollow tupelo gums in the swamps of southeastern Missouri.<sup>1</sup> In the fall, just prior to the southward migration, large numbers of swifts often gather into a flock and roost by thousands in some large chimney.

**Ruby-throated Hummingbird.** *Archilochus colubris*.

This tiny hummingbird is a common summer resident in most parts of Arkansas. The earliest date of its arrival at Helena is March 31 (average, April 9) and it remains until October (average, October 6; latest, October 8). At Delight it was seen as late as October 25. Hummingbirds readily adapt themselves to civilized surroundings and are often seen in town and city gardens, but are equally at home in the depths of the wilderness. I observed them frequently on Rich Mountain from base to summit and found them also in the timbered bottoms at Turrell and McGehee. They are reported as breeding at Pea Ridge, Clinton, Pettigrew, Mammoth Spring, Big Lake, and Delight.

**Scissor-tailed Flycatcher.** *Muscivora forficata*.

This handsome flycatcher is a summer resident of the prairies from Kansas to southern Texas. Its range extends east to eastern Oklahoma and casually to Arkansas. Bendire, in giving its distribution, says: "Occasional in \* \* \* western Arkansas" and, although no definite locality is given, this statement doubtless refers to the region about Fort Smith, where Capt. Bendire was stationed in 1860. On May 28, 1910, I saw from the train one of these birds a little south of Spiro, Okla., about 10 miles west of the Arkansas boundary.

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<sup>1</sup> Birds of Missouri, p. 132, 1907.

**Kingbird.** *Tyrannus tyrannus.*

The kingbird is a common and generally distributed summer resident, arriving in spring about April 15 and remaining until late September (last seen at Helena September 27). It is recorded as breeding at Clinton, Pea Ridge, and Big Lake, and I found it in the breeding season at Stuttgart, Mammoth Spring, Conway, Pettigrew, and Rich Mountain (2,600 feet). Its food consists almost wholly of insects, including many noxious species, supplemented by a small percentage of wild berries and fruits. It has been accused of preying extensively upon honeybees, but examination of 624 stomachs in the Biological Survey showed only 22 containing these insects, 61 in all, including 51 drones, 8 workers, and 2 indeterminate. It is evident, therefore, that the species as a whole is not greatly injurious to apiaries.

**Crested Flycatcher.** *Myiarchus crinitus.*

This large flycatcher occurs as a common summer resident in all parts of the State. The earliest arrivals in spring are noted at Helena April 12 (average, April 17), and the fall migration is performed chiefly in September. The species has been reported as breeding at Clinton, Newport, Helena, and Delight. I found it in the breeding season at Mammoth Spring, Stuttgart, Wilmot, Pettigrew, Conway, and Rich Mountain. At the latter place it was common everywhere on the mountain from base to summit. The food of this bird consists of beetles, locusts, crickets, ants, flies, moths, and other insects, with some wild fruit.

**Phoebe.** *Sayornis phoebe.*

The phoebe or "bridge pewee" is one of the commonest of the flycatchers in summer in the mountains and foothills, but is not found at that season in the lowlands. It has been recorded from Fayetteville, Pea Ridge, and Clinton. I found it at Pettigrew, Chester, Cotter, Mammoth Spring, and Rich Mountain, the latter point marking its southern limit as a breeder. The bird is common all over this mountain, and a nest with eggs was found May 27 at the summit. It is the hardiest member of the family and in winter occurs nearly throughout the State. The first migrants from the north were seen at Delight on October 11, and by October 27 the species was common. It has been recorded at Clinton and Helena in January.

The phoebe is one of our most useful birds, its food consisting mainly of insects, among them many noxious species, such as click beetles, May beetles, and weevils, including the boll weevil. Its nest is fixed on the side of a cliff, the rafters or abutments of a bridge, or under the eaves of a house or farm building.

**[Say Phoebe.** *Sayornis sayus.*

This is a western species, breeding east to western Texas and Kansas, and has occurred also as a straggler in Missouri, Wisconsin, and other eastern States. The only record for Arkansas is the very indefinite one given by Audubon, who includes the State in its range, without comment.<sup>1</sup>)

<sup>1</sup> Birds of Amer., I, p. 218, 1840.

**Olive-sided Flycatcher.** *Nuttallornis borealis.*

The olive-sided is one of the northern-breeding flycatchers, found in Arkansas only during migration. It passes north in May and south in September. A specimen was taken by Mr. W. G. Savage at Delight, September 12, 1910—the only record for the State.

**Wood Pewee.** *Myiochanes virens.*

The wood pewee is perhaps the best known of our flycatchers, and is generally distributed as a summer resident. Its favorite haunts are open woodlands and orchards, and in such situations its pleasing song may be heard throughout the heat of summer.

The first migrants reach Helena about the middle of April (earliest date, April 12) and remain till October (latest, October 12). The species is recorded as breeding at Mammoth Spring, Wilmot, Delight, Rich Mountain, Pettigrew, Clinton, Camden, and other places. Like the other flycatchers, it chooses as food mainly insects, including beetles, crane flies, dragon flies, ants, grasshoppers, tent caterpillars, and moths.

**Yellow-bellied Flycatcher.** *Empidonax flaviventris.*

This is one of the smaller flycatchers and so quiet and inconspicuous that it is rarely seen. It breeds in the northern States and Canada and passes south in winter to Central America. It may be found in Arkansas during May and again in September. Savage has taken two specimens at Delight, September 3 and 16, 1910, and these are the only records from the State.

**Acadian Flycatcher.** *Empidonax virens.*

This retiring little bird is a lover of wooded ravines and bottom-land timber, occurring commonly as a summer resident. The first arrivals in spring reach Helena about April 23 (earliest record, April 20), and the last seen at Delight were noted September 12. The species is reported as nesting at Clinton and Helena, and I found it at nearly every locality visited, including Mammoth Spring, Cotter, Pettigrew, Chester, Rich Mountain, and Wilmot. At the latter place I found a nest, June 26, in a cypress tree growing in the edge of the lake near town; the parent birds were feeding young in the nest. This flycatcher feeds upon various insects, such as beetles, flies, and wasps, and occasionally eats wild berries.

**Traill Flycatcher.** *Empidonax trailli.*

This species is rather rare and of local distribution in Arkansas. It is an inhabitant of the prairies and open valleys, but is not found in heavy timber. On the Grand Prairie at Stuttgart I found it fairly common, living in orchards, dooryards, and about small clumps of trees on the prairie.<sup>1</sup> A specimen was taken there May 13 and

<sup>1</sup> This is the type region of *trailli*, Audubon having described the species in 1828 from a pair of birds which he collected on the "prairie lands of the Arkansas River."

another was secured at Chester, June 4, in a clump of bushes along a creek running through a cultivated field. The only other record for the State is furnished by Miss Cavaness, who reports the bird breeding at Monticello.

**[Least Flycatcher. *Empidonax minimus*.**

This little flycatcher, although difficult to distinguish by its colors from the Traill, is easily recognized by its abrupt call. It is a common and regular migrant in the Mississippi Valley, occurring in April and May and again in September and October. Further observations will undoubtedly reveal its presence as a bird of Arkansas.]

**Prairie Horned Lark. *Otocoris alpestris praticola*.**

The horned lark occurs as a migrant and winter visitant and locally as a breeder in the Ozark region. It has been found nesting at Helena only once, in May, 1911. Harvey reports it as "resident" at Fayetteville, and since it is known to occur in summer in several of the southern counties of Missouri<sup>1</sup> it will probably be found breeding in suitable localities in northern Arkansas. At Helena it is reported to occur in migration, and at Van Buren, December 28, 1910, Hanna saw a flock of 22, from which he collected 5 specimens. Horned larks are hardy birds, nesting in early spring often before the snows have melted. They are ground dwellers for the most part, but at mating time often indulge in a flight song after the manner of the famous skylark of Europe.

**[Magpie. *Pica pica hudsonia*.**

The only evidence of the occurrence of this western species in Arkansas is Audubon's inclusion of that State in his definition of the bird's range.<sup>2</sup> It may still occasionally wander into the western part of the State.]

**Blue Jay. *Cyanocitta cristata*.**

The blue jay is common throughout the State, occurring both in the lowlands and on the mountains. Although partially migratory in the northern part of its range, it is found in Arkansas during the entire year. Probably the native birds migrate to some extent, or at least wander rather widely in search of food, and in winter their numbers are increased by the arrival of migrants from the north. Blue jays are reported abundant in winter at Fayetteville, Van Buren, Clinton, Stuttgart, and Helena. They breed at all those places and have been noted also in summer at Lake City, McGehee, Wilmot, Rich Mountain, Pettigrew, and Mammoth Spring. The food of the jay is made up mainly of acorns and other nuts, with the addition of various insects, such as beetles, grasshoppers, and caterpillars, and a relatively small amount (about 19 per cent of the total) of grain, chiefly corn.

<sup>1</sup> Found by Mr. O. Widmann near West Plains, Howell County, and between Doniphan and Pleasant Grove, Ripley County. (Reported in a letter to the author.)

<sup>2</sup> Birds of America, IV, p. 103, 1856.

**Raven.** *Corvus corax sinuatus.*

Ravens formerly occurred rarely in the mountains of Arkansas and there may still be a few remaining in the wilder and more inaccessible parts. Pleas reported in 1890 that they bred on cliffs in the highest hills of Van Buren County, near Copeland, and Monroe reported them breeding in the region about Newport in 1884—probably in the hills to the westward.

**Crow.** *Corvus brachyrhynchos.*

Crows are generally distributed in the State in both summer and winter, but apparently are nowhere very abundant. They are reported to breed at Clinton (rare), Newport, Helena (rare), and Delight (uncommon). I noted them in small numbers at Cotter, Womble, Mena, Pettigrew, and Chester, and at Conway and Mammoth Spring they were fairly numerous. With the exception of 3 or 4 in the heron rookery at Walker Lake, none were seen in the bottom lands of eastern Arkansas. In winter the species is recorded as rare at Stuttgart, Clinton, Van Buren, Helena, and Fayetteville.

The crow subsists on a great variety of food. Careful study of its diet by the Biological Survey shows that about 26 per cent of its food consists of insects, mainly injurious species, about 21 per cent of corn, and the rest of various grains, nuts, seeds, etc.

**Clarke Nutcracker.** *Nucifraga columbiana.*

The only record of this bird's occurrence in Arkansas is given by Mr. Robert H. Mitchell, who states that a specimen was killed at Earl, Crittenden County, about April 1, 1891.<sup>1</sup> The species inhabits the mountains of the western United States, and is only a straggler east of Colorado and the Black Hills.

**Bobolink.** *Dolichonyx oryzivorus.*

The bobolink, or "ricebird," as it is called in the South, is an irregular migrant in the Mississippi Valley, and probably never is so abundant as on the Atlantic coast. Its summer home is on the prairies from northern Missouri northward and in the northeastern States. Migrating flocks have been observed at Helena, May 13, 1894, and April 20, 1904, and at Newport it was reported abundant in 1884 from May 7 to 19. At Stuttgart, May 11 to 14, 1910, I saw several hundred birds, mostly males, in flocks numbering 10 to 20. No records of its fall migration are at hand, but the species is known to leave Missouri the latter part of August and arrive in southern Louisiana between September 1 and 15. A decidedly useful bird in its northern home, the bobolink becomes a serious pest when it reaches the rice fields of the South Atlantic States. It may prove injurious

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<sup>1</sup> Auk, XI, p. 327, 1894.

to the rice industry of Arkansas, but on account of the comparatively small number of these birds which migrate through the Mississippi Valley the damage done by them will be much less severe than on the Atlantic coast.

**Cowbird.** *Molothrus ater.*

The cowbird occurs locally in moderate numbers over most of the State. It has been reported as a breeder at Clinton, Newport, Big Lake, and Delight, and I found it in the breeding season at Stuttgart, McGehee, Wilmot, Camden, Gurdon, Mena, Pettigrew, and Mammoth Spring. At McGehee it was fairly numerous in the clearings and more open timber, and one of its eggs was found, May 16, in a yellow-breasted chat's nest. There is only one report of its occurrence in the State in winter—at Helena—but doubtless it will be found to be plentiful at that season. At Stuttgart I was told that this species joins other blackbirds in depredations on rice, but up to date no serious damage to this newly established industry has been reported. The food of the cowbird consists largely of weed seed, with the addition of grain and insects in about equal proportions. It has been found to capture limited numbers of boll weevils.

**Yellow-headed Blackbird.** *Xanthocephalus xanthocephalus.*

This western species probably occurs occasionally in western Arkansas, since it is known to breed as near the State as Jasper County, Mo. The only record seems to be that given by Cabot, of a specimen said to have been taken in Arkansas by Maj. Townsend and donated to the Boston Society of Natural History.<sup>1</sup>

**Red-winged Blackbird.** *Agelaius phoeniceus phoeniceus.*

The redwing is an abundant resident in many sections of the State, particularly on the prairies and throughout the marshy areas of the eastern part. It is known to breed at Lake City, Stuttgart, Mammoth Spring, Helena, Wilmot, and Chester. It was abundant on the prairie at Stuttgart and several nests were found, May 12, containing one to four eggs. In that locality, blackbirds were reported to do some damage to sprouting rice, and probably this species is largely responsible for the depredations. In winter also the redwing is abundant in the State, as indicated by reports from Fayetteville (Harvey), Van Buren (Hanna), and Stuttgart (Holister). Its food consists largely of weed seed, with a small amount of grain (oats, corn, and wheat) and a fair proportion (about 25 per cent) of insects, among which a few boll weevils have been found.

**Thick-billed Redwing.** *Agelaius phoeniceus fortis.*

This northwestern form of the red-winged blackbird occurs in Arkansas only as a migrant and winter visitant, and it is probably rather rare. Only one record is known—that of a bird taken by Mr. G. Dallas Hanna at Van Buren, December 10, 1910.

<sup>1</sup> Proc. Boston Soc. Nat. Hist., II, p. 259, 1847.

**Northern Redwing.** *Agelaius phoeniceus arctolegus*.

Like the preceding, this subspecies is a winter visitor in the State, known thus far only from 5 specimens taken by Hanna at Van Buren, December 10 and 17, 1910.

**Meadowlark.** *Sturnella magna magna*.

The meadowlark or "field lark," as it is often called, is a locally common resident in the State, but is rare or absent from mountainous and heavily timbered areas.

The northern form (*magna*) is not known to breed within our limits, but when summer specimens are secured from the Ozark region, they may prove to be of this subspecies. It is reported as occurring in mild winters at Fayetteville (Harvey), and Hanna collected two specimens from a flock of 35 at Van Buren on December 17. This is a highly beneficial species, its food consisting mainly of injurious insects, with a small percentage of seeds and some grain, mostly waste corn picked up about the fields in winter and early spring. It has been shown to be an important enemy of the cotton-boll weevil, and for this reason, if for no other, should be carefully protected.

**Southern Meadowlark.** *Sturnella magna argutula*.

The southern form of the meadowlark occurs as a summer resident in favorable situations over the greater part of the State, exclusive of the Ozark region. Specimens taken in summer have been examined from Blytheville, Stuttgart, Conway, and near Mammoth Spring, and the bird is reported to breed also at Newport and Helena. I found it abundant on the prairie at Stuttgart and in old fields at Wilmot, and fairly common at McGehee, but it is apparently very scarce in the southwestern part of the State. Savage reports it absent in summer at Delight, but appearing there in migration September 29 and becoming common by the middle of October. Some of these migrants, however, may be the northern form (*magna*). Both forms probably occur together in winter throughout the lowlands of the State. The species is reported abundant at that season at Stuttgart (Hollister) and Judsonia.<sup>1</sup>

**[Western Meadowlark.** *Sturnella neglecta*.

Since the breeding range of the western meadowlark overlaps that of the eastern species in western Missouri (Johnson and Vernon Counties), the bird may be looked for as a migrant and possibly as a breeder in extreme western Arkansas. Although difficult to distinguish by its markings, the western bird is easily recognized by its striking song.]

**Orchard Oriole.** *Icterus spurius*.

The orchard oriole is a common summer resident in most parts of Arkansas. The average date of its arrival at Helena in spring is April 10 (earliest date March 30). It departs early, usually in late August or early September. It has been reported from Newport,

<sup>1</sup> Reynolds, Am. Nat., XI, p. 307, 1877.

Clinton, and Delight, and I found it fairly common at Stuttgart, Conway, Mammoth Spring, Camden, and Wilmot. At the latter place, young just out of the nest were observed June 24. The species seems to be rather rare in the mountainous sections of the State. I noticed only one bird at Mena, and there are no records for the Ozark region except at Clinton, where it is reported rare. Orioles are mainly insectivorous in their diet, and among the good qualities of these very useful birds is their pronounced liking for boll weevils. Investigations in the cotton fields of Texas and Louisiana showed that nearly one-third of the stomachs of this species collected there contained remains of this pest.

**Baltimore Oriole.** *Icterus galbula.*

This handsome oriole is fairly common locally in summer, mainly in the eastern part of the State. It is reported common at Helena, where it arrives from the south about April 10 (earliest date, April 4). At Clinton it is given as a rare breeder, at Hopefield as tolerably common,<sup>1</sup> and it is reported as breeding at Newport, Big Lake, and Pea Ridge. I found the species at Stuttgart (May 14), Mammoth Spring (June 15), and a few other places in the eastern part of the State, but nowhere was it common. At Delight it is a rare migrant, first seen in autumn on September 1. The food of this oriole consists mainly of insects, and caterpillars form a large part. Like the other orioles, it is an important enemy of the boll weevil. A little fruit is included in its diet, but not enough to counterbalance its usefulness as an insect-destroyer.

**Rusty Blackbird.** *Euphagus carolinus.*

The rusty blackbird is a northern-breeding species and occurs only in migration and as a winter resident. Hollister reports it common near Stuttgart in winter, and Pleas gives it as a migrant at Clinton, seen November 5, 1889. Hanna noted a flock of 10 at Van Buren on December 17 and collected several specimens on that date and 1 on January 7. This blackbird forages mainly in pastures and swamps, where it destroys many noxious insects. In winter it eats some grain, most of which is probably waste picked up in the fields.

**Brewer Blackbird.** *Euphagus cyanocephalus.*

This blackbird is the western representative of the rusty and ranges east in winter casually to Arkansas and Louisiana. Hollister reports a few seen in winter on the prairie at Stuttgart in company with rusty blackbirds.<sup>2</sup> Savage noted a flock of 13 at Delight November 17, and 2 birds on January 5.

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<sup>1</sup> Hay, O. P., Bull. Nutt. Orn. Club, VII, p. 92, 1882.

<sup>2</sup> Wilson Bull., IX, p. 14, 1902.

**Bronzed Grackle.** *Quiscalus quiscula zeneus*.

The crow blackbird, as this species is often called, is common over a large part of the State, particularly in the bottom lands of the eastern half and in certain valleys of the western part. None were seen in the mountains proper. It is reported as breeding at Clinton, Newport, Helena, and Hopefield, and was noted as common at Fayetteville in March and September (probably breeding). Several flocks were seen at Van Buren in December (Hanna) and a large flock at Delight on February 2 (Savage, 1911). I found it common and breeding at Mammoth Spring, Lake City, Turrell, Conway, and Wilmot. McAtee found it abundant at Big Lake June 20 to 23, 1911. The adults were feeding well-grown young and were alert in seizing minnows which sprang upon the banks to escape larger fishes. At Helena it is common both summer and winter, and after the breeding season large flocks are often seen flying to and from their roosts. The diet of this bird includes both animal matter (insects) and vegetable matter in the proportion of about 30 per cent of the former to 70 per cent of the latter. The vegetable matter consists mainly of corn, with a little other grain and considerable mast. A good share of the corn is waste picked up in the fields, but the grackles are sometimes destructive to corn in the ear. Among the insects eaten are grasshoppers and various beetles, including the boll weevil.

**English Sparrow.** *Passer domesticus*.

The English sparrow is said to have been introduced at Hot Springs between 1876 and 1880, but prior to this (in 1871) it had been introduced into Memphis, Tenn., and doubtless spread first into Arkansas from that point, so that by the end of the year 1886 it had established itself over a considerable area in the northeastern part of the State, with a few isolated colonies in the western part. Here, as everywhere in America, it has increased with amazing rapidity and is now found in practically every town and village in the State, as well as on a great majority of the farms. Almost everywhere it is regarded as a pest by reason of its destruction of grain, fruit, and garden vegetables, its defacement of public buildings and of dwelling houses, and its habit of driving away native birds. At times it feeds to some extent on insects, but its destruction of them compensates to only a slight degree for the damage it does, and hence its destruction is advocated in a circular issued by the Biological Survey describing the best methods of ridding localities of this feathered nuisance.

**Purple Finch.** *Carpodacus purpureus*.

The purple finch is a regular and not uncommon migrant and winter resident. In 1910 the first flock, numbering about 20, arrived at Delight November 10 and in a few days the species became common, remaining so all winter. It has been reported at Helena at various

dates between January 21 and April 23 and is given as a winter visitant at Clinton. Hanna collected 6 specimens at Van Buren between November 29 and December 22. Purple finches are usually found in flocks during the winter season, when they feed largely on the buds and seeds of various trees.

**Crossbill.** *Loxia curvirostra minor.*

The red crossbill is a rare and irregular visitant in Arkansas. It has twice been reported from Clinton—April 6, 1889 (in numbers), and May 5, 1890 (one), these being the only records from the State.

**Goldfinch.** *Astragalinus tristis.*

The goldfinch, often called "wild canary" or "thistle bird," is an abundant winter resident in all parts of the State and a fairly common summer resident in the north central and northwestern counties, south in the mountains to Polk and Montgomery Counties. It is reported as breeding at Clinton, and I found it at Womble (May 22), Rich Mountain (May 25-28), Pettigrew (May 30), Chester (June 4), and Hoxie (June 22). It was noted by Preble as common at Fayetteville in September. Savage reports a flock of 20 seen at Delight November 19, and Hanna found it numerous at Van Buren between November 30 and December 17. Mrs. Stephenson reports its occurrence at Helena between September 8 and May 1, and states that immense flocks are often seen there during April and May and in November. In winter the goldfinch feeds largely on weed seeds, the seeds of birches, and those of the buttonbush. In summer it subsists to a large extent on weed seed, but destroys many noxious insects, such as cankerworms, plant lice, small grasshoppers, and beetles (Forbush).

**[Pine Siskin.** *Spinus pinus.*

The siskin occurs in winter over most of the United States, and may therefore be looked for at that season in Arkansas. It was rather common in Shannon and Grandin Counties, Mo., in April and May, 1907.<sup>1</sup>

**Lapland Longspur.** *Calcarius lapponicus.*

This Arctic-breeding bird is a common winter resident in the Mississippi Valley as far south as Arkansas and Texas. Mr. Howard Ayers, writing from Fort Smith in 1879, states: "They [the longspurs] appear in this part of the State about November in small flocks, but as it grows cold they collect in immense numbers and scatter again as spring comes (about 1st of February)."<sup>2</sup> The species is reported also as a rare visitor at Clinton, where it was seen October 13, 1889, and February 4 and April 30, 1890. During the winter of 1882-1883 it was abundant at Fayetteville.<sup>3</sup>

<sup>1</sup> Widmann, O., *Birds of Missouri*, p. 171, 1907.

<sup>2</sup> Coues, *Bull. Nutt. Orn. Club*, IV, p. 238, 1879.

<sup>3</sup> Cooke, W. W., *Orn. and Ool.*, VIII, p. 34, 1883.

**Smith Longspur.** *Calcarius pictus.*

This species breeds on the Barren Grounds of Canada and passes the winter on the prairies of the Mississippi Valley. There is only one record of its occurrence in Arkansas—a specimen collected by Prof. Harvey at Fayetteville February 28, 1885,<sup>1</sup> but the species is undoubtedly more common in the State than the scarcity of records indicates.

**Vesper Sparrow.** *Poocetes gramineus.*

The vesper sparrow or grass finch occurs commonly in the lower Mississippi Valley as a migrant and winter resident. Savage noted its arrival at Delight October 25, and by November 4 it had become common and remained so until about April 1. It has been reported as a migrant at Clinton and as a breeder at Newport,<sup>2</sup> but the latter record is doubtless an error, since it is not known to breed south of St. Clair County, Mo. It is a ground-feeding bird, easily recognized in flight by the white outer tail feathers.

**Savannah Sparrow.** *Passerculus sandwichensis savanna.*

This little grass sparrow is a common migrant in both spring and fall, and many remain in the State all winter. The fall migration is performed mainly in October and November. The first birds arrived from the north at Delight October 5, and by November 10 they had become common, remaining until the middle of May. I saw 20 or more at Lake City April 29 and 30 and found them common on the prairie and along roadsides near Stuttgart May 11 to 14. A belated migrant was seen at McGehee May 17. The Savannah is one of the most useful of the sparrows. Nearly half its food consists of insects, beetles being most eagerly sought, and in winter it consumes large quantities of grass seeds and weed seeds. Individuals taken in cotton fields in winter were found to have eaten a number of boll weevils.

**Grasshopper Sparrow.** *Ammodramus savannarum australis.*

The grasshopper sparrow, so called because of its insectlike song, occurs probably as a rare or local summer resident, but on account of its retiring habits its presence is not easily detected. It is a dweller in grass fields and rarely seeks a higher perch than a fence or a weed stalk. It is recorded as a breeder at Newport, and will doubtless be found also at various points in the State in winter as well as in summer.

**Henslow Sparrow.** *Passerherbulus henslowi.*

This is another of the small ground-dwelling sparrows whose shyness causes it to be easily overlooked. It lives in old fields and marshes and sings its odd little song on some weed stalk. The species is a locally common summer resident in Missouri, and will probably be found breeding in suitable situations in Arkansas.]

<sup>1</sup> Cooke, W. W., Bull. 2, Div. Econ. Orn., p. 186, 1888.

<sup>2</sup> Ibid., p. 188.

**Leconte Sparrow.** *Passerherbulus lecontei*.

This species probably occurs quite regularly as a migrant and winter resident, but, like the other ground-dwelling sparrows, its presence in a locality is often unsuspected. One specimen was taken at Fayetteville by Prof. Harvey February 28, 1885,<sup>1</sup> and 2 at Van Buren by Mr. G. Dallas Hanna January 7, 1911. About 8 were seen on the latter date in a pasture where the grass was half knee high.

**Nelson Sparrow.** *Passerherbulus nelsoni*.

This sparrow breeds in Canada and the Dakotas and migrates through the Mississippi Valley in spring and fall. It is a marsh-dwelling bird and even in migration resorts to wet meadows. I saw one on the prairie near Stuttgart May 14 and several in the valley at Mena May 24, when I secured a specimen. These are the only records from the State.

**Lark Sparrow.** *Chondestes grammacus*.

Although occurring in various parts of the State, this species can not be called common as a summer resident except in a few localities, but as a migrant it may at times be plentiful. Its winter home is mainly south of the United States. It is reported as a common breeder at Delight, Pike County, arriving from the south April 8 and leaving by September 17. I found it fairly common at Mammoth Spring in June and noted it in small numbers at Lake City (May 1—probably migrants), Conway, Camden, and Eldorado. At Helena it is rare, and Mrs. Stephenson has noted it only twice, April 14, 1904, and April 23, 1905. It was seen at Clinton, April 23, 1890. The food of this sparrow is made up of seeds of weeds, grasses, and grain, with about 27 per cent of insects. It is considered to be one of the most valuable of the sparrows as a destroyer of grasshoppers.

**Harris Sparrow.** *Zonotrichia querula*.

This sparrow is a common migrant in western Missouri, eastern Kansas, and Oklahoma, and probably occurs regularly in western Arkansas. The only record from the State, however, is that furnished by Mr. G. Dallas Hanna, who collected a specimen at Van Buren on January 7, 1911.

**White-crowned Sparrow.** *Zonotrichia leucophrys leucophrys*.

The whitecrown is an abundant migrant and an uncommon winter resident. Migrants reach the State in the fall from their northern home about the last of October, and in spring the migratory movements extend from March to the middle of May.

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<sup>1</sup> Cooke, W. W., Bull. 2, Div. Econ. Orn., p. 191, 1888.

Hollister found a few of these sparrows at Stuttgart in January, Hanna noted them in small numbers at Van Buren in December, and Pleas reported them as occasionally wintering at Clinton. Mrs. Stephenson has observed them at Helena between April 17 and May 7, and Savage reports them common at Delight between April 2 and May 18. I saw 2 at Stuttgart May 13, and 1 at McGehee May 17.

**Gambel Sparrow.** *Zonotrichia leucophrys gambeli*.

This western form of the white-crowned sparrow occurs rarely in migration as far east as Arkansas. Three specimens taken by Mr. G. Dallas Hanna at Van Buren on December 14, 16, and 22, 1910, furnish the only records for the State.

**White-throated Sparrow.** *Zonotrichia albicollis*.

The whitethroat occurs in great abundance as a migrant and winter resident. It arrives in the vicinity of Helena about October 10 and remains until the middle of May (latest date, May 19). Savage noted it at Delight in spring as late as May 16, and I found it numerous at Turrell between May 6 and 10. The first fall migrants reached Delight October 23, becoming common by November 5. Hanna found the whitethroat the most abundant species at Van Buren during December. Like many of the members of its family, this sparrow is a great destroyer of weed seed and has an especial fondness for the seeds of ragweed and bindweed (*Polygonum*). It consumes, also, a great many wild berries and a goodly number of insects. Its food habits in general place it among the useful birds of the farm.

**Tree Sparrow.** *Spizella monticola*.

This hardy little bird breeds in the far north and spends the winter in the northern United States and as far south as Oklahoma. Its status in Arkansas is not well known, since it has been observed at only one locality—Helena, October 25, 1895, and October 30, 31, 1896. Prof. Cooke found these sparrows abundant at Caddo, Okla., between October 31 and February 26, a few remaining until March 10,<sup>1</sup> and they may be expected to occur in Arkansas at about the same dates.

**Chipping Sparrow.** *Spizella passerina*.

The "chippy" is one of our most abundant and familiar sparrows. It is found in all sections of the State, having been observed at Lake City, Turrell, Wilmot, Mena, Pettigrew, Conway, and other places. It arrives from the south early in March (earliest record at Helena, March 5) and remains until November (latest at Helena, November 6). Occasionally a few may be found in winter, as at Delight, where Savage took a single specimen on December 20. This little bird

<sup>1</sup> Bull. 2, Div. Econ. Orn., p. 198, 1888.



*Rouis Agassiz Puerto.*

A WINTER SEED-EATER. THE WHITE-THROATED SPARROW.



often makes its home in dooryards and village gardens, and renders good service to man by destroying great quantities of weed seed (notably crab grass) and of noxious insects, which constitute about one-fourth of its food.

[Clay-colored Sparrow. *Spizella pallida*.

This little sparrow, which closely resembles the chipping sparrow, occurs commonly in migration in the Mississippi Valley, breeding from Nebraska northward. It passes through Missouri in April and May and again in September and October, and should be found also in Arkansas during those months.]

Field Sparrow. *Spizella pusilla pusilla*.

The field sparrow occurs as an abundant migrant and winter resident, but is found in the breeding season mainly in the northern and northwestern parts of the State. It is reported as breeding at Clinton, and I found it fairly common at Pettigrew and at Hoxie. Two birds heard singing at Stuttgart May 14 were probably breeders, but the species is very rare in summer so far south. During the summer of 1910 Mrs. Stephenson heard it singing constantly at Helena as late as July 24, but that is the first year in which it had been seen there in the breeding season. Hollister reports it very abundant at Stuttgart in November, and Hanna found it common at Van Buren in December. Mrs. Stephenson heard the first song of this species at Helena March 23, and the last migrants in spring leave there by April 21. At Delight the last spring migrant was seen on April 10 and the first fall migrant October 10, the species becoming common November 4.

Western Field Sparrow. *Spizella pusilla arenacea*.

This subspecies may be expected to occur casually during migrations and in winter. The only record is furnished by Mr. G. Dallas Hanna, who collected 2 specimens at Van Buren on January 7, 1911.

Slate-colored Junco. *Junco hyemalis*.

The junco, or "snowbird," is a common winter resident, arriving from the north about the last of October (earliest date at Helena, October 24) and remaining until the middle of April (latest date April 22). It is reported abundant at Stuttgart in November and January (Hollister), at Van Buren in December (Hanna), and common at Fayetteville on February 27 (Harvey). At Delight the species arrived about November 1 and departed northward by April 6. The food of this bird during its stay in the south is almost wholly composed of the seeds of various weeds and grasses.

Bachman Sparrow. *Peucaea aestivalis bachmani*.

This sparrow is a rather rare and local summer resident, usually found in old pastures. I secured a single specimen at Conway on June 7 and another (a singing male) at Camden on July 7. At

Hoxie, on June 22, in a pasture dotted with a few clumps of trees, I saw 4 or 5 of the birds, most of them singing. Sayage observed 2 individuals at Delight on September 1.

**Song Sparrow.** *Melospiza melodia.*

The familiar song sparrow of the Northern States is found in Arkansas only as a migrant and winter resident. The fall movement brings it to the State in late October, where it remains until March or April. At Delight the first migrants in fall were noted November 10. It was reported as abundant in November and January at Stuttgart (Hollister) and at Van Buren in December (Hanna). Harvey noted it at Fayetteville February 28. At Helena it is recorded as a migrant only, though doubtless occurring there all winter. Like the other sparrows, it eats mainly seeds of weeds and grasses and a fair proportion of insects.

**Lincoln Sparrow.** *Melospiza lincolni.*

This sparrow is a common migrant in the Mississippi Valley and a winter resident in the southern part. Although it has been observed in Arkansas only a few times, it probably occurs regularly in moderate numbers. At Stuttgart, on May 12 and 13, I shot 2 specimens and saw several more. Hanna noted the species at Van Buren in small numbers between November 29 and December 22 and secured 6 specimens.

**Swamp Sparrow.** *Melospiza georgiana.*

The swamp sparrow breeds from northern Missouri northward and winters in the southern half of the United States. As its name indicates, it is an inhabitant of swamps, but in winter is often found in brushy fields. Its northward migration is performed in March and April; the southward movement in October. The species was observed by Sayage at Delight between April 20 and May 6, and I saw a few at Lake City April 28 and 29. It is reported common in winter at Fayetteville (Harvey) and at Van Buren, where Hanna secured 8 specimens in December.

**Fox Sparrow.** *Passerella iliaca.*

This large and handsome sparrow occurs commonly as a migrant and winter resident. Mrs. Stephenson has noted it at Helena between November 4 and February 18, but considers it of rare and irregular occurrence. It is reported also as wintering at Clinton and Delight, and Hanna found it common at Van Buren in December. In northward migration it should be found during March and April.

**Towhee.** *Pipilo erythrophthalmus.*

The towhee or chewink, one of the largest of the sparrow family, occurs as a common migrant and winter resident, but in the breeding season is restricted mainly to the Ozark region. It is reported

as breeding at Clinton (rare) and near Newport. I found it fairly common at Pettigrew, but did not observe any in the mountains south of the Arkansas River. It has been noted in migration at Lake City, Helena, Hardy, Benton, and Turrell. At Delight the first fall migrant was seen October 8. In winter it has been recorded as common at Fayetteville<sup>1</sup> and at Stuttgart (Hollister). At Van Buren, on December 28, 8 birds were seen and one secured by Hanna. This bird is a ground dweller and seeks its food mainly by scratching among fallen leaves and rubbish in the woods or thickets. It destroys beetles and their larvæ, ants, moths, caterpillars, grasshoppers, flies, and earthworms; it takes also a considerable amount of weed seed and some wild fruits and berries.

**Cardinal Grosbeak.** *Cardinalis cardinalis.*

The cardinal, or redbird, as it is often called, is one of the commonest and most widely distributed birds of the State. It is most abundant, however, in the river-bottom thickets and in the lowlands generally. I observed none on Rich Mountain and only a few in the hills around Pettigrew, but at all other places visited it was very common.

The species is nonmigratory and is fully as abundant in winter as in summer. It has been recorded from a large number of localities in the State, including the following: Fayetteville, Van Buren, Mena, Camden, Wilmot, Stuttgart, Conway, Lake City, and Mammoth Spring. The food of the cardinal consists of weed seeds, seeds of wild fruits, and various insects, the latter forming about one-third of the total. The insects eaten include a number of serious pests, such as the Rocky Mountain locust, Colorado potato beetle, cotton-leaf worm, bollworm, boll weevil, and codling moth.

**Rose-breasted Grosbeak.** *Zamelodia ludoviciana.*

This grosbeak, as far as our records show, occurs only as a migrant, but since it has been found breeding as far south as Lawrence County, Mo.,<sup>2</sup> it may yet be discovered in Arkansas in summer. The bird has been noted by Mrs. Stephenson at Helena between April 27 and May 10, but is considered rare in that locality. Six individuals were seen at Clinton May 3, 1890. In the fall it may be looked for in September and October.

**Blue Grosbeak.** *Guiraca cærulea.*

The blue grosbeak is a fairly common summer resident in southern and southwestern Missouri as well as in Texas and Oklahoma. We should therefore expect to find it more or less common in Arkansas, but I did not observe the bird at any point visited, except at Mam-

<sup>1</sup> Cooke, Orn. and Ool., VIII, p. 34, 1883.

<sup>2</sup> Widmann, O., Birds of Missouri, p. 195, 1907.

moth Spring, where I saw one male on June 15 as I was driving over the hills. I had a near view of his distinctive colors, but did not secure the specimen. The species arrives from the south in late April and remains until October.

**Indigo Bunting.** *Passerina cyanea.*

The indigo bird is an abundant summer resident in all parts of the State. The first migrants from the south arrive about the middle of April (earliest date at Helena, April 17) and by the 1st of May the species is common. On the lowlands at Lake City and near Blytheville I found it very common from April 30 to May 3. The southward movement takes place in September and early October, and the winter is passed in Mexico and Central America. The last one seen at Delight was noted October 10. The species has been observed at Clinton, Pettigrew, Rich Mountain, Wilmot, Big Lake, Stuttgart, Conway, and Mammoth Spring. The indigo eats mainly weed seeds and various insects, and is said to be especially fond of grasshoppers and caterpillars.

**Painted Bunting.** *Passerina ciris.*

This beautiful little sparrow—the most brilliantly marked member of its family—is a rather uncommon summer resident, occurring most plentifully in the lowlands of the southeastern part of the State. At Helena it breeds regularly in moderate numbers, arriving from the south about the middle of April (earliest date, April 10). I saw a pair at McGehee May 17, and found several breeding pairs at Wilmot in June. Young just out of the nest were seen at the latter place June 24. This species has been observed at Eureka Springs by Philo W. Smith, jr.—probably a casual occurrence.<sup>1</sup>

**Dickcissel.** *Spiza americana.*

The dickcissel, or black-throated bunting, is a locally common summer resident in the State. Having a marked preference for level grass fields, it is infrequently found in hilly regions, but is abundant on the prairies, as at Stuttgart, where I observed the birds, May 11 to 14, singing with characteristic vehemence from fences, bushes, and weed stalks. In the heavily timbered bottom lands along the Mississippi it is rare, even as a migrant, and probably never breeds there, unless it be in open, long-cultivated areas. It has been observed but once by Mrs. Stephenson at Helena—May 4, 1902. Numbers arrived at Newport, April 27, 1884,<sup>2</sup> and on April 30, 1910, I observed a single migrant at Lake City. One bird was observed also at Fort Smith May 29, and one at Camden July 6. The fall migration takes place mainly in September, and before cold weather

<sup>1</sup> Wildmann, O., *Birds of Missouri*, p. 198, 1907.

<sup>2</sup> Cooke, W. W., *Bull. 2, Div. Econ. Orn.*, p. 221, 1888.

all have passed on to their winter home in South America. The dickcissel is a most useful bird on the farm, destroying large numbers of grasshoppers, crickets, and other injurious insects. About one-third of its food in summer consists of seeds, including a little grain..

**Scarlet Tanager.** *Piranga erythromelas*.

This brilliant tanager occurs as a summer resident in the northern and western parts of Arkansas as far south as Faulkner County and the Ouachita Mountains. The first migrants from the south arrive at Helena about April 10 and in the fall the species departs in September and October. The first birds from farther north reached

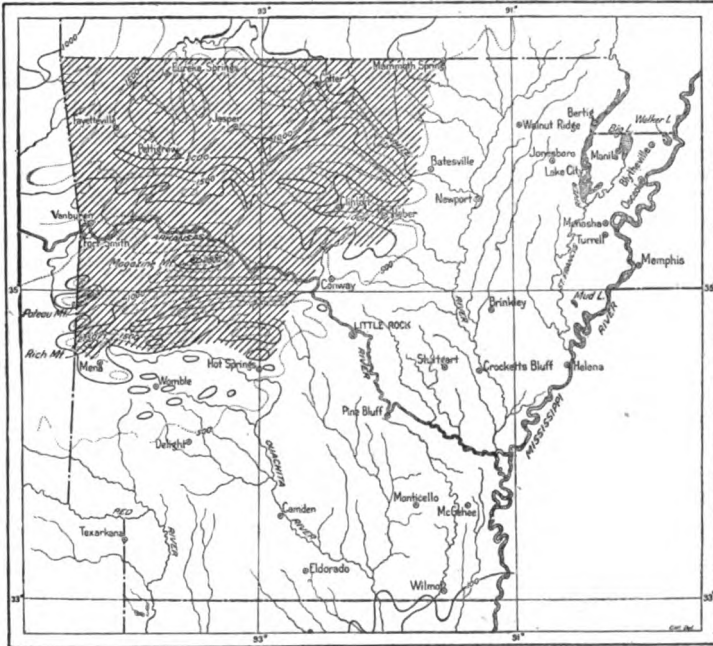


FIG. 3.—Breeding area of the scarlet tanager (*Piranga erythromelas*) in Arkansas.

Delight on September 17. The species is recorded as breeding at Heber,<sup>1</sup> Eureka Springs, and Clinton, and I found it in summer at Mammoth Spring, Conway (one June 6), Chester, Pettigrew (common), and Rich Mountain (common). The last locality apparently marks its southern limit as a breeder in the State. One male seen at McGehee May 17 was probably a belated migrant. Scarlet tanagers are lovers of oak woods, where they render valuable service in the destruction of caterpillars, moths, and beetles.

**Summer Tanager.** *Piranga rubra*.

The summer tanager is a common summer resident over the greater part of the State, except on the higher mountains. It usually arrives at Helena during the second week in April (earliest date,

<sup>1</sup> Widmann, O., Birds of Missouri, p. 199, 1907.

April 7) and departs in early October (latest date, October 2). At Delight it was noted as late as October 13. It is reported as a common breeder at Clinton, Newport, and Delight. I found it in every locality visited, except on Rich Mountain, including the following: Mammoth Spring, Conway, Wilmot, Camden, Womble, Mena, Pettigrew (in valleys), and Cotter.

This tanager has received the name of "bee bird" on account of its habit of feeding on honeybees. Its food during the spring and early summer is said to consist chiefly of various kinds of large coleopterous insects, bees, wasps, and others. Later in the season it feeds chiefly on blueberries and other small fruits.<sup>1</sup>

**Purple Martin.** *Progne subis*.

The familiar martin is a common and generally distributed summer resident. Although formerly nesting in hollow trees and reported as doing so as late as 1889 (at Clinton), its present abundance in a given locality is largely dependent on the number of boxes put up for its accommodation. From its winter home in South America the martin arrives in Arkansas usually about the first week in March (earliest record at Helena, February 18, 1897), but does not become common until late in March or early in April. By April 10, at Helena, it has usually begun to nest. Fall migration takes place early, most of the birds leaving the United States in late August and early September. This species has been reported as breeding at Fayetteville, Pea Ridge, Clinton, Newport, Helena, and Delight. I found it at Mammoth Spring, Lake City, Turrell, Stuttgart, McGehee, Wilmot, Eldorado, Camden, Womble, Mena, Conway, Cotter, and Pettigrew. At the last-mentioned place a few pairs were found breeding on the top of a mountain at about 2,200 feet altitude. Martins are strictly insectivorous and have been found to capture boll weevils. Farmers should make special efforts to increase their numbers around the farm.

**Cliff Swallow.** *Petrochelidon lunifrons*.

The cliff swallow is a common migrant in the Mississippi Valley and breeds in the northern part as far south as central Arkansas. The species is an irregular migrant, but may be expected in spring between the first week in April and the middle of May, and is usually again common in late August and September. At Stuttgart, May 12 and 13, 1910, I noted several small flocks of these birds. As a breeder it is rare and local, the only reports being from Clinton and Pea Ridge. During its southward migration in September this species feeds extensively upon the boll weevil, and when that insect is abundant it forms the principal food of this swallow. Of 35 specimens collected in the Texas cotton fields, all but one had eaten boll weevils, the total number destroyed by the 34 birds being 638.

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<sup>1</sup> Bald, Brewer, and Ridgway, *Hist. N. Am. Birds*, I, p. 443, 1874.

**Barn Swallow.** *Hirundo erythrogastra.*

The barn swallow is a common migrant in Arkansas, but occurs in the breeding season only rarely and locally. Spring migration occurs from about the first of April to the middle of May and the fall movement takes place chiefly during August and September. I noted the species in small numbers in migration at Turrell May 9, Stuttgart May 12 to 14, and Arkansas City May 15. Preble saw one at Fayetteville September 23. The only report of its breeding in the State is at Clinton, in 1890. Like the cliff swallow, this swallow has been found to be very useful in destroying boll weevils in fall. Of 14 birds collected in Texas in September, 5 had eaten a total of 52 weevils.

**Tree Swallow.** *Iridoprocne bicolor.*

This species is a common migrant in the Mississippi Valley, passing northward at intervals during March, April, and early May, and southward in late September and October. On the St. Francis River, north of Bertig, I saw a flock of about 50 of these swallows April 30, 1909, and the next day at Kennett, Mo., saw a flock of more than a thousand feeding over fields near the river. Preble found the species common at Fort Smith between September 15 and 23 (1892). Widmann records it as a rare summer resident as far south in Missouri as the southern border of Dunklin County. Mr. Widmann writes me that in May, 1894, he found a nest with eggs in a stump in the middle of the St. Francis River, about a mile south of Bertig. The bird probably occurs occasionally, therefore, as a breeder in the Sunken Lands of northeastern Arkansas.

**Bank Swallow.** *Riparia riparia.*

The bank swallow is an abundant migrant and a locally common summer resident. It is with some difficulty distinguished in flight from the rough-winged swallow, which often nests in banks but never in large colonies as does the bank swallow. The present species breeds commonly at Helena. In some seasons as many as 300 nest holes have been observed there by Mrs. Stephenson. The birds arrive usually about the first of April (earliest date, March 26) and depart during August and September.

This swallow is reported, also, to breed along the Mississippi in the vicinity of Hopefield.<sup>1</sup> There are no other positive breeding records for the State, and I failed to find the species during my 1910 trip. Like the other members of its family, it feeds upon various winged insects, including the boll weevil.

**Rough-winged Swallow.** *Stelgidopteryx serripennis.*

The roughwing occurs as a fairly common migrant and summer resident. It nests both in cut banks and in cliffs, usually only a few pairs in a locality. Migrants from the south arrive at Helena about

<sup>1</sup> Hay, O. P., Bull. Nuttall Ornith. Club, VII, p. 91, 1882.

March 23 (earliest record, March 21) and are last seen there about September 21. I observed the species in small numbers at Lake City, Walker Lake, Turrell, Arkansas City, Camden, Cotter, and Mammoth Spring. McAtee found small numbers at Big Lake, June, 1911. It probably breeds sparingly throughout the State wherever it can find suitable nesting sites.

**Cedar Waxwing.** *Bombycilla cedrorum.*

The cedar bird occurs as an irregular migrant and winter visitant and in the northern part as a rare breeder. It is reported as breeding at Clinton and was noted there also on November 10 and January 5 and 16. I saw a flock of 10 or 12 at Pettigrew on June 1, and the species probably breeds in that vicinity and in other parts of the Ozark region. A flock of 6, probably migrants, was noted at McGehee May 17. Savage noted it during every month in summer at Delight, but found no nests. At Helena the cedar bird is given by Mrs. Stephenson as an irregular visitant noted on numerous dates between February 4 and May 23 and in November. At Van Buren Hanna observed several small flocks in December and early January. The cedar bird feeds more extensively upon fruit and less upon insects than most small birds, and its fondness for cherries has gained for it the name of "cherry bird." However, examination of 152 stomachs by the Biological Survey showed only 9 containing cherries, while about three-fourths of the total food consisted of wild fruits or seeds. Insects constitute about 13 per cent of its food, and include such forms as cankerworms, grasshoppers, beetles, bugs, and scale insects. In winter great flocks of these birds are often seen feeding on hackberries or other wild fruit.

**Northern Shrike.** *Lanius borealis.*

The northern shrike, or "butcher bird," is a rare winter visitant, only two having been recorded—one seen at Fayetteville by Prof. Harvey and the other at Van Buren in December, 1910, by Mr. Hanna. Its habits are similar to those of its southern relative, the loggerhead shrike.

**Migrant Shrike.** *Lanius ludovicianus migrans.*

This shrike, known as "loggerhead" and "French mocking bird" in the South, is rather uncommon and of local distribution in summer in Arkansas. It is common in migration and occurs also in winter, probably more abundantly than in summer. It has been reported in the breeding season at Clinton, Newport, and Helena, and in migration at Fort Smith, Fayetteville, and West Point. At Delight specimens were taken August 8 and 22 and September 16 and 23. In winter it has been reported from Fayetteville, Stuttgart (common;

Hollister), and Van Buren (5 specimens, December 7-30; Hanna). I found it at only two localities, McGehee and Wilmot, in each of which it breeds in small numbers. Specimens taken at these places, as well as those from Delight and Van Buren, are referable to the subspecies *migrans*. The typical form seems not to occur in the State. The shrike is a decidedly useful bird, feeding in summer largely upon injurious insects, such as grasshoppers, crickets, caterpillars, cankerworms, and cutworms. It captures mice at all seasons, and in winter these rodents form about half of its food. At this season small birds are occasionally eaten. Shrikes frequently impale their prey upon thorns or barbed wire and apparently many more victims are impaled than are eaten.

**Red-eyed Vireo.** *Vireosylva olivacea*.

The familiar red-eyed vireo is one of the commonest and most evenly distributed of our woodland song birds, being found in all timbered regions both in the lowlands and on the mountains. Migrants arrive at Helena from the south about April 10 (earliest, March 30) and depart in autumn about the first of October (last, October 5). The species has been observed at Fayetteville, Clinton, Mammoth Spring, Lake City, Wilmot, Womble, Rich Mountain, Pettigrew, Conway, and other places. A nest with young was found at Eldorado July 4. By reason of its abundance and its well-known habit of searching every leaf on the trees for caterpillars and the like, this bird must be reckoned as one of our most valuable assistants in the work of conserving the forests.

**Philadelphia Vireo.** *Vireosylva philadelphia*.

This vireo, which resembles the warbling vireo in appearance but sings much like the red-eyed, is a rare but regular migrant in the Mississippi Valley. In Missouri it occurs in May and in September and October and in Arkansas should be found during the same months.]

**Warbling Vireo.** *Vireosylva gilva*.

The warbling vireo has a peculiar distribution in the lower Mississippi Valley, occurring as a breeder, so far as known, only in the immediate vicinity of the Mississippi River. The only record of the species in Arkansas is from Helena, where it is reported by Mrs. Stephenson as a common summer resident, arriving from the south about March 30 and departing in early October (latest, October 5). The bird is a lover of tall trees and is often found in elms or other shade trees along country roads and village streets.

**Yellow-throated Vireo.** *Lanivireo flavifrons*.

This vireo is a common summer resident in all parts of the State. It lives in upland timber tracts in company with the red-eye and is partial also to small groves and to shade trees on village streets.

Migrants from the south reach Helena about the first week of April (earliest, March 24) and the return movement takes place during September and early October. The species was noted during the summer months at Mammoth Spring, Lake City, Conway, McGehee, Eldorado, Delight, Rich Mountain, and Pettigrew. Like the other vireos the yellowthroat is mainly insectivorous, and its food includes a variety of caterpillars, moths, beetles, etc., as well as house flies and mosquitoes.

**Blue-headed Vireo.** *Lanivireo solitarius.*

The solitary or blue-headed vireo occurs as a migrant in the Mississippi Valley, breeding from Minnesota northward. It should be found regularly in Arkansas in the latter half of April and again in September and October. The only record for the State, however, is furnished by Savage, who saw 2 birds at Delight on October 22.

**White-eyed Vireo.** *Vireo griseus.*

The white-eyed vireo is almost as common as the red-eye and, like it, is generally distributed. It occurs in both the mountains and the lowlands, and is especially abundant in wet river bottom timber where thickets and tangles of briars cover the ground. It arrives at Helena usually about the first of April (earliest, March 23) and remains until the middle of October (latest, October 16). It is reported as breeding at Clinton, Pea Ridge, Newport, Helena, Big Lake, and Delight. I observed it at Rich Mountain, Pettigrew, Conway, Mammoth Spring, and Turrell.

**Bell Vireo.** *Vireo belli.*

This is the rarest of the vireos and of very local distribution in Arkansas. It is most numerous in prairie regions and occurs also to some extent in rolling foothill country. I found this species rather common on the Grand Prairie about Stuttgart May 11-14, living in the copses and hedges and even in dooryards close to town. At Conway in June it was fairly common, and at Fort Smith several breeding pairs were located in a peach orchard near town. One was seen at Gurdon May 20.

**Black-and-white Warbler.** *Mniotilta varia.*

The black-and-white "creeper" occurs as a summer resident over the greater part of the State, but is rare or absent from the extreme southern part. It arrives at Helena from the south about the first of April (earliest, March 20) and remains until October. It has been reported as a breeder at Clinton, Newport, Hopefield, and Helena. I found it at Mammoth Spring, Turrell, Conway, Delight, Rich Mountain, and Pettigrew. At most of these localities it probably breeds,

but is nowhere common. This warbler is a typical woodland bird and is most at home in tracts of heavy timber, where it renders valuable service in the destruction of wood-boring insects, bark-beetles, and other injurious insects.

**Prothonotary Warbler.** *Protonotaria citrea*.

The prothonotary or golden swamp warbler is a common summer resident in the swamps and river bottoms of the southern and eastern part of the State. It arrives from the south about the first of April and departs in September. It is reported as breeding at Clinton, Newport, and Helena. I found it common at Wilmot and along the St. Francis River at Lake City. Several were seen at Camden in July, one on Cadron River near Conway June 6, and one on White River at Cotter June 8. It is numerous at Big Lake (McAtee, June, 1911). This brilliant little bird is a prominent and attractive feature of the big swamps, where it may often be seen flitting lightly over the water or prying into rotten stumps in search of insects, in securing which it shows almost as much dexterity as a flycatcher.

**Swainson Warbler.** *Helinaia swainsoni*.

This is another of the swamp-inhabiting warblers; but, unlike the prothonotary, is rare and very shy. It is an inhabitant of river-bottom timber, where it seeks concealment among the canebrakes and dense thickets of climbing vines, often remaining motionless for many minutes as it repeats at frequent intervals its rather loud and pleasing song. Although constantly on the alert for sight or sound of this bird, I detected it in only three localities. One was seen at Turrell May 8 and heard singing several times on succeeding days. Another was seen and heard singing in the Cadron River bottoms near Conway June 6, and several were noted at Camden July 4-7.

**Worm-eating Warbler.** *Helmitheros vermivorus*.

This warbler is a rare and local summer resident, occurring, as far as known, only in the mountains and foothills in the northern and western part of the State. It is reported as breeding in the hills west of Newport, and I saw two on Rich Mountain in Polk County May 25. The latter locality probably marks the southern limit of its breeding range. This bird bears a rather inappropriate name, since its food, as far as known, consists not of worms but of beetles, spiders, and ants.

**Bachman Warbler.** *Vermivora bachmani*.

This inconspicuous little warbler has a rather restricted range, having been found in the breeding season only on the coast of South Carolina and Georgia, in western Kentucky (near Russellville), and in the Sunken Lands of Arkansas and Missouri. The species was

described by Audubon in 1833 and was not found again in the United States for over 50 years, when it was discovered in Louisiana. Its occurrence in Arkansas was first made known by Mr. Otto Widmann, who discovered it on Boland Island, Greene County, in May, 1896, and the following year found the nest with eggs in Dunklin County, Missouri.<sup>1</sup> The bird is a moderately common breeder in the Sunken Lands of northeastern Arkansas. I saw one at Turrell April 28, 1910, and on May 10 collected two specimens at the same place in heavy timber with a dense undergrowth of cane. One was seen May 4 in the cypresses on Walker Lake. On the St. Francis River, 12 miles above Bertig, I found the birds rather numerous in 1909 (April 25-28) on the Missouri side of the river, and probably they are equally common on the Arkansas side.

**Blue-winged Warbler.** *Vermivora pinus*.

This warbler is a summer resident in the Mississippi Valley from Missouri northward, and probably occurs rarely at that season in extreme northern Arkansas. I observed one bird, probably a migrant, at Turrell on May 7 and a singing male in southern Missouri, near Mammoth Spring, Arkansas, June 13, which I believe was breeding in that vicinity. Mrs. Stephenson has observed the species once in migration at Helena May 13, 1894, and Mr. Savage noted three south-bound migrants at Delight on August 20, 1910.

**[Golden-winged Warbler.** *Vermivora chrysoptera*.

This species occurs in the Mississippi Valley as a common migrant, breeding from central Minnesota northward. It may be looked for in Arkansas in late April and early May and again in September.]

**Nashville Warbler.** *Vermivora rubricapilla*.

The Nashville warbler is a common migrant in the Mississippi Valley in both spring and fall and breeds from Nebraska northward. The spring migration takes place chiefly between April 20 and May 10, and the return movement begins in August and continues through September and October. Savage noted two very early fall migrants at Delight August 20, and Preble collected a specimen and saw several more at Fort Smith September 19. Further investigation will doubtless show that the bird is a regular migrant in the State.

**[Orange-crowned Warbler.** *Vermivora celata*.

The orange-crown breeds in Canada and winters in the Gulf States and Mexico. It probably occurs regularly in migration in Arkansas and should be looked for in late April and May and in September and October.]

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<sup>1</sup> Auk, XIII, p. 264, 1896; XIV, pp. 305-310, 1897.

**Tennessee Warbler.** *Vermivora peregrina.*

The Tennessee is one of the commonest of the wood warblers in migration, occurring in both spring and fall. Its summer home is in Canada and the northern United States. A single bird was noted at Delight as early as April 6 (Savage), but at Helena the species is usually observed between April 19 and May 12. I saw numbers of them at Lake City between April 30 and May 2 and at Walker Lake May 4 and 5. The fall migration takes place chiefly between September 15 and October 15.

**Western Parula Warbler.** *Compothlypis americana ramaLinæ.*

This tiny warbler is a very common summer resident in most parts of the State. It arrives in the vicinity of Helena about the first of April (earliest, March 24) and departs about the first of October. I observed the species in numbers at Mammoth Spring, Conway, Wilmot, Camden, Womble, Chester, Pettigrew, and Cotter, and it probably breeds in all those localities. Specimens were collected at Chester and Womble. There are no definite fall records. This species is an inhabitant of river-bottom timber and builds its nest usually in a bunch of hanging moss. Its food is said to consist largely of spiders, caterpillars, small flies, and beetles.

**[Cape May Warbler.** *Dendroica tigrina.*

This is one of the rarer warblers, but occurs quite regularly in migration in the Mississippi Valley on its way to and from its summer home in Canada. It may be looked for in Arkansas in late April or May and again in September.]

**Yellow Warbler.** *Dendroica æstiva.*

The yellow warbler occurs as a summer resident in the northern and northwestern parts of Arkansas, but apparently does not breed south of the Ozarks and their foothills. It is reported as a rare breeder at Clinton, but does not occur in summer at Helena. I found it in the breeding season at Pettigrew (common), Chester, Cotter, and Mammoth Spring. It appears in migration at Helena between April 14 and May 15. In the fall it leaves very early, passing south from the last of July to the middle of September. One was noted by Preble September 16, at Fort Smith. The yellow warbler is at times domestic in its habits, often taking up its abode in orchards and in trees or shrubbery surrounding farm and village houses. It is considered one of the most useful birds of the farm, feeding largely on caterpillars, cankerworms, barkbeetles, wood-boring beetles, and weevils (Forbush).

**Black-throated Blue Warbler.** *Dendroica cærulescens.*

This is a northern breeding species, occurring in the Mississippi Valley in migration during April, May, and September. There is only one record from Arkansas—a bird seen by Mrs. Stephenson at Helena, April 7, 1904.

**Myrtle Warbler.** *Dendroica coronata.*

The myrtle warbler is the hardiest of the warblers and the only one which winters in the Middle States. Its summer home is from the northern United States northward nearly to the Arctic Ocean. It occurs as an abundant migrant and winter resident, arriving from the north in October and departing in the spring in early May (latest date seen at Helena, May 12). It was abundant at Stuttgart in November (Hollister) and at Van Buren between November 25 and January 7 (Hanna). It has been observed in migration at Clinton, Lake City, and Delight. This bird owes its common name to its fondness for the berries of the wax myrtle (*Myrica cerifera*) and related species, which in some regions furnish its principal winter food. In the Mississippi Valley, however, it is said to feed extensively on berries of the poison ivy and to some extent on red cedar berries. It consumes also many insects.

**Magnolia Warbler.** *Dendroica magnolia.*

The magnolia or black-and-yellow warbler is a common migrant in Arkansas, passing north in May on the way to its summer home in Canada and returning in September and early October. It has been observed at Helena between May 1 and 19, at Lake City May 2, and at Turrell May 9. It is probably rare in the western part of the State, but three were seen by Mr. Savage at Delight on April 29, 1911.

**Cerulean Warbler.** *Dendroica cerulea.*

The cerulean warbler is a common summer resident in nearly all wooded parts of the State. Its distribution is apparently limited only by the occurrence of heavy deciduous woodland, for the bird is equally common in the river bottoms of the Mississippi and on the slopes of the mountains. Its favorite haunts are in the tops of the tallest trees, and except for its song its presence would rarely be detected. At Rich Mountain, May 23 to 28, it was singing almost constantly, and ranged nearly or quite to 2,500 feet altitude. In the Ozark hills about Pettigrew it was noted occasionally, but the timber there is not sufficiently dense to prove very attractive to this bird. I observed the species frequently in the Sunken Lands at Lake City and Walker Lake, and less commonly at Mammoth Spring, Conway, Wilmot, Camden, Womble, Chester, and Cotter. The average date of arrival of this bird at Helena is April 7 and the earliest record March 27.

**Chestnut-sided Warbler.** *Dendroica pensylvanica.*

This species breeds from Iron County, Mo., and Illinois northward and eastward, mainly in the Transition zone. It is a regular and not uncommon transient visitant, passing north in early May and

returning in September. It has been observed a few times by Mrs. Stephenson at Helena between May 1 and 16, and I saw 2 at McGehee May 17, 1910.

[**Bay-breasted Warbler.** *Dendroica castanea*.

The baybreast is a rather uncommon but regular migrant in the Mississippi Valley, and may be looked for in Arkansas in May and in September and October. It breeds in Canada and the Northern States.]

**Black-poll Warbler.** *Dendroica striata*.

The blackpoll, although one of the most abundant warblers in the northern and eastern States, is a rather uncommon migrant in the lower Mississippi Valley. This is explained by a study of its migration route, which shows that most individuals of the species enter the United States in spring by way of Florida and then pursue a course across the middle and eastern States to their summer home in the extreme northern United States, Canada, and Alaska. The bird has been observed only a few times in Arkansas—once by Mrs. Stephenson, at Helena, May 3, 1904, and twice by myself at Turrell, May 7, 1910, and at Rich Mountain, May 26 and 27—but it is doubtless rather more common than these few records would indicate. It is one of the very latest migrants in spring, passing north from May 1 to June 1. The southward movement is chiefly during September and October.

[**Blackburnian Warbler.** *Dendroica fusca*.

This handsome warbler is a moderately common migrant in the Mississippi Valley, and breeds from central Minnesota northward. It is found in Missouri from the last of April to the last of May and in September and October, and may be looked for in Arkansas at about the same dates.]

**Sycamore Warbler.** *Dendroica dominica albilora*.

This species is a rather uncommon summer resident, found chiefly in the swamps and river bottoms of the eastern part of the State, where it lives in the tall cypresses, sycamores, and other bottom-land trees. It has been noted at Helena between April 10 and 21, but doubtless arrives somewhat earlier than that, since it has been seen at Hornersville, Mo., on March 21 (Widmann). In fall it has been observed at Helena as late as October 10. Other records of its occurrence in the State are at Hardy, Lake City, and Walker Lake.

**Black-throated Green Warbler.** *Dendroica virens*.

This warbler occurs as a common transient visitant in spring and fall. It has been observed at Helena a number of times between April 8 and May 16. I noted it at Lake City May 1 and at Walker Lake May 4. Fall migration takes place in September and October. In its summer home in the Northern States and Canada this bird dwells mainly in pines, but in migration it may be found in both evergreen and deciduous timber.

**Pine Warbler.** *Dendroica vigorsii*.

The pine warbler, as its name implies, is an inhabitant of pine timber, and indeed is practically confined in the breeding season to regions in which considerable tracts of pine occur. Although partly migratory, the species occurs throughout the year in Arkansas. The more northern breeding birds move south in winter and occupy, in company with their southern breeding relatives, the pine forests of the Southern States. I found this warbler abundant in the breeding season near Delight, fairly common near Womble, and rather uncommon at Mena, Pettigrew, Eldorado, and Camden. It has been reported as breeding in the hills west of Newport. This is one of the few birds that lives exclusively in pine trees, and as it feeds to a large extent on the insects infesting those trees, it is considered a valuable species. Its food in winter includes, besides insects, a considerable amount of vegetable matter, such as dogwood and sumac berries and pine seeds.

**[Palm Warbler.** *Dendroica palmarum*.

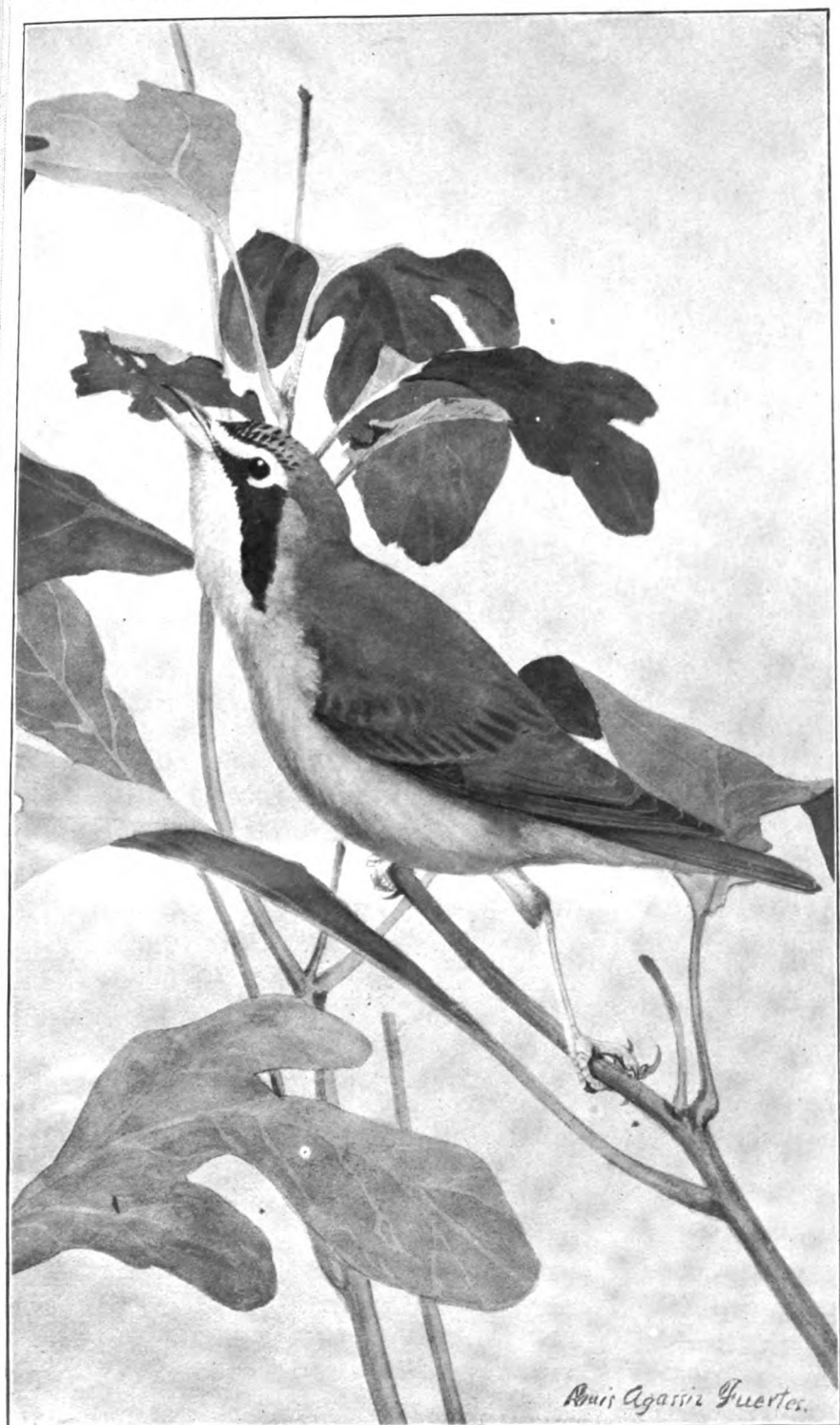
The palm or red-poll warbler is a common transient visitant in the Mississippi Valley and breeds in Canada and northern Minnesota. It is one of the earliest warblers to migrate, passing north through Missouri from early April to the middle of May and returning during October. It should be found regularly in Arkansas.]

**Prairie Warbler.** *Dendroica discolor*.

This warbler is a fairly common summer resident, arriving from the south about the middle of April and remaining until the middle of September. Its name is rather inappropriate, since the bird is not found in prairie regions, but makes its home usually in brushy clearings among second-growth sprouts. It was noted at Helena between April 22 and 27, 1904, but apparently is not a regular breeder in the eastern part of the State. It is a common summer resident at Delight (where it arrived April 9, 1911), and I noted several at Mena and Rich Mountain. It breeds also in small numbers at Chester, Pettigrew, Conway, and Mammoth Spring.

**Ovenbird.** *Seiurus aurocapillus*.

The ovenbird, so named from the fancied resemblance of its domed nest to an old-fashioned oven, is one of the ground warblers and a dweller in deciduous woodland. It occurs commonly as a migrant, but as a breeder only in the mountains and foothills of the northern and western parts of the State. It is reported as a fairly common summer resident at Clinton, where it arrived from the south on April 24. I found it very common and breeding both on Rich Mountain and in the Ozark hills around Pettigrew. A migrant was observed at Turrell on May 9 and at Helena the species has been noted a few times between May 1 and 19.



A SUMMER RESIDENT INSECT-EATER. THE KENTUCKY WARBLER.



**Grinnell Water-thrush.** *Seiurus noveboracensis notabilis.*

This subspecies, the western form of the water-thrush, is a common migrant through the Mississippi Valley and breeds from northern Minnesota northward to Alaska. It is, of course, not a thrush at all, in spite of its name, but a ground warbler related to the ovenbird. It frequents swamps and creek and river bottoms. I noted several birds of the species at Turrell May 7, and this seems to be the only record from the State. The bird is probably of regular occurrence, however, and may be looked for between April 20 and May 15 and again from the last of August till October.

**Louisiana Water-thrush.** *Seiurus motacilla.*

The Louisiana or large-billed water-thrush is a southern breeding species, finding its northern limit in southern Nebraska and Minnesota. It is a fairly common summer resident in Arkansas, arriving from the south about the middle of March and departing in October. It frequents wooded ravines in the hills and, to some extent, wet river-bottom timber. It is reported as breeding at Clinton, Newport, and Helena. I found it rather common in summer at Mammoth Spring, and noted a few at Pettigrew, Chester, and Cotter. At Womble a nest just completed was found May 22, and at Camden I collected a full-plumaged young bird July 6.

**Kentucky Warbler.** *Oporornis formosus.*

This warbler is a common and generally distributed summer resident in the wooded parts of the State. It is a lover of damp, river-bottom woods, but is found also in ravines and along streams well up on the mountains. It is reported as a breeder at Clinton, Newport, Helena, and Delight. I found it at Pettigrew, Rich Mountain, Camden, Wilmot, and Turrell. The first migrants of this species were seen at Delight April 10, and at Helena April 13 (average date of arrival at Helena, April 20). In the fall it was last noted at Delight on September 4, but is seen only occasionally after the middle of August.

**[Connecticut Warbler.** *Oporornis agilis.*

The Connecticut warbler is a rather common migrant in spring in the Mississippi Valley, and breeds in Michigan, Minnesota, and Manitoba. Its fall migration is mainly east of the Alleghenies, and the bird is rare in the Mississippi Valley. It should occur regularly in Arkansas during the first half of May.]

**Mourning Warbler.** *Oporornis philadelphia.*

The mourning warbler, so named from the black hood it wears, is a regular and not uncommon migrant in the Mississippi Valley, breeding from central Minnesota northward. Its spring migration is performed during May and its fall migration in September. It has been observed but once in Arkansas—at Helena, May 2, 1909, by Mrs. Stephenson.

**Maryland Yellowthroat.** *Geothlypis trichas trichas*.

This little warbler is one of the commonest of our small birds and inhabits a variety of situations, including open swamps, marshy fields, brier patches, and brushy clearings. It is found all over the State—in timbered bottoms, on prairies, and in the valleys among the mountains. The average date of arrival in spring at Helena is April 11 and the earliest record April 4. In fall most of the birds pass south in late September or October. The species is recorded as a breeder at Clinton, Helena, Stuttgart, Wilmot, Camden, Mena, Chester, Pettigrew, Conway, Mammoth Spring, and other places. Specimens have been examined from Stuttgart, Wilmot, Mena, and Chester, and all prove referable to the typical form. At Turrell, May 7, I found a nest with 5 eggs on the slope of a railroad embankment within 10 feet of the track. The yellowthroat is a decidedly useful bird on the farm, feeding upon many injurious insects, such as leafhoppers, grasshoppers, cankerworms, and other caterpillars, beetles, moths, etc.

**Yellow-breasted Chat.** *Icteria virens*.

This bird, the largest member of the warbler family, is a common and generally distributed summer resident, occurring in suitable situations from the Mississippi bottoms to the tops of the highest mountains. The average date of arrival in spring at Helena is April 20 (earliest record, April 7). After the breeding season the birds quickly desert their summer homes, and by the middle of September practically all have left for the south. The last one seen at Delight was noted September 10. The species is recorded as a breeder at Mammoth Spring, Clinton, Newport, Helena, Stuttgart, Wilmot, Delight, Rich Mountain (base to summit), Pettigrew, Cotter, and other places. At McGehee, May 16, I found in a bunch of weeds a nest containing 3 eggs of the chat and one of the cowbird.

The chat is a lover of thickets and bushy pastures, where its curious whistling song may be heard at almost any hour of the day or night. Although usually shy, it occasionally launches into the air and, with legs dangling and wings raised high above the body, pours forth a medley of erratic notes. It is largely insectivorous, and has been known to feed on tent caterpillars, wasps, and beetles. In addition, it takes some vegetable food, as wild berries and seeds.

**Hooded Warbler.** *Wilsonia citrina*.

This brilliant little bird is a locally common summer resident, living in heavy bottom-land timber grown up to cane thickets, as well as in the drier brushy timber tracts on the mountain sides. I found it common on Rich Mountain nearly to the summit, and in a deep

wooded ravine on the south side discovered a nest with three young May 28. The bird was common also at Pettigrew in the Ozarks and at Turrell in the Sunken Lands. A few were noted at Camden in July. Mrs. Stephenson reports it as breeding at Helena, arriving usually about April 5 (earliest, March 31). It remains on its breeding grounds until September and passes south during that month.

**Wilson Warbler.** *Wilsonia pusilla.*

The Wilson black-cap warbler is a fairly common transient visitant in the Mississippi Valley and breeds from northern Minnesota northward. It is probably of regular occurrence in Arkansas, but has been observed only at Helena, where Mrs. Stephenson has noted it on various dates between April 30 and May 17.

**Canada Warbler.** *Wilsonia canadensis.*

This species nests in Canada and the cooler parts of the United States and occurs in the Mississippi Valley as a common transient visitant in spring and fall. It has been observed at Helena between May 2 and 15 (Stephenson) and at Delight between April 25 and 30 (Savage), these being the only records from the State.

**Redstart.** *Setophaga ruticilla.*

This brilliant little warbler is a fairly common summer resident. The male bird may be recognized by the orange bands on wings and tail and the female by corresponding bands of yellow. It is most numerous in the heavily timbered bottom lands of the eastern part of the State and is reported as a common breeder at Helena, where it arrives from the south usually about April 10 (earliest record, March 31) and departs in August and September (last seen, September 30). It is given as a breeder at Clinton by Pleas and at Big Lake by McAtee. I found it fairly common at McGehee and Camden and noted a few at Cotter on White River and at Wilmot.

The redstart is an extremely active bird and is an expert flycatcher. Its food consists, according to Forbush, of caterpillars, bugs, moths, gnats, flies, small grasshoppers, and beetles.

**Pipit.** *Anthus rubescens.*

The pipit, or "titlark," nests in the Arctic regions and on high mountains and winters from the Middle States southward. In winter it is found usually in large flocks, frequenting meadows and plowed fields. It resembles in general appearance a small, brown, streaked sparrow, but may be distinguished by its slender bill and the white outer tail feathers and by its habit of walking instead of hopping. The species is probably a not uncommon winter resident in Arkansas, but there are only a few records of its occurrence. I noted four

birds—belated migrants—at Lake City, April 29, and Hanna collected 5 specimens from a flock of 25 at Van Buren on December 24. The food of the pipit is largely insectivorous. It seems to be especially fond of weevils and has been found to be an important enemy of the boll weevil, large numbers of which it destroys in winter and spring. On the farm pipits often follow the plowman and pick up larvæ of ground beetles, weevils, and other insects.

**Sprague Pipit.** *Anthus spraguei*.

This is a western species, occurring regularly in migration as far east as eastern Nebraska and Oklahoma. There is one record from Arkansas published many years ago by Dr. Elliott Coues, who quotes from a letter received from Mr. Howard Ayers and dated Fort Smith, February 26, 1879, in which the writer states that this bird appears in that vicinity about November in small flocks and later in immense numbers, mingling with Lapland longspurs and remaining until February.<sup>1</sup> It seems highly probable, however, that this observer was in part mistaken, and that many, if not most, of the pipits seen were the common species (*Anthus rubescens*).

**Mocking Bird.** *Mimus polyglottos*.

The mocking bird, one of the best-known birds in the State, is a common and generally distributed permanent resident. It is essentially a bird of cultivated regions, and is rather uncommon in heavily timbered regions and in the higher mountains. None were seen on Rich Mountain, although they were numerous in the valley around Mena. At Pettigrew the bird was scarce and at Mammoth Spring rather uncommon, but at all other places visited, including Lake City, Conway, Stuttgart, Wilmot, Camden, and Womble, it was abundant. At Clinton it is reported as a rare breeder in the valleys. In winter it is reported common at Stuttgart (Hollister), and Van Buren (Hanna). This bird is sometimes destructive to grapes, figs, and other small fruits. On the other hand, it renders good service by destroying noxious insects, such as grasshoppers, crickets, caterpillars, beetles, cutworms, cotton worms, and boll weevils. Its food includes also various seeds and wild berries, including the seeds of dogwood, hackberry, red cedar, holly, and pokeberry.

**Catbird.** *Dumetella carolinensis*.

The catbird is a common summer resident over the greater part of the State. It was not observed on Rich Mountain, but at Pettigrew, in the Ozarks, it is fairly common. It is reported as breeding also at Pea Ridge, Clinton, Newport, and Helena. I found it numerous at Mammoth Spring, Turrell, Wilmot, Camden, and Delight. The

<sup>1</sup> Bull. Nutt. Orn. Club, IV, p. 238, 1879.

first migrants of this species arrive at Helena about the middle of April, and the last birds leave about the first week in October. The last one seen at Delight was noted October 10. A few winter in favorable localities in the State and McAtee noted them as fairly common in Crittenden and St. Francis Counties November 12-18, 1910. The Biological Survey's study of the catbird's food habits indicates that it subsists largely on fruit, of which about one-third is cultivated, the remainder of wild species, such as blackberries, wild cherries, mulberries, elderberries, and the fruit of the dogwood, sour gum, sumac, and poison ivy. Insects constituted about 44 per cent of the total food in the stomachs examined, and included ants, beetles, cater-

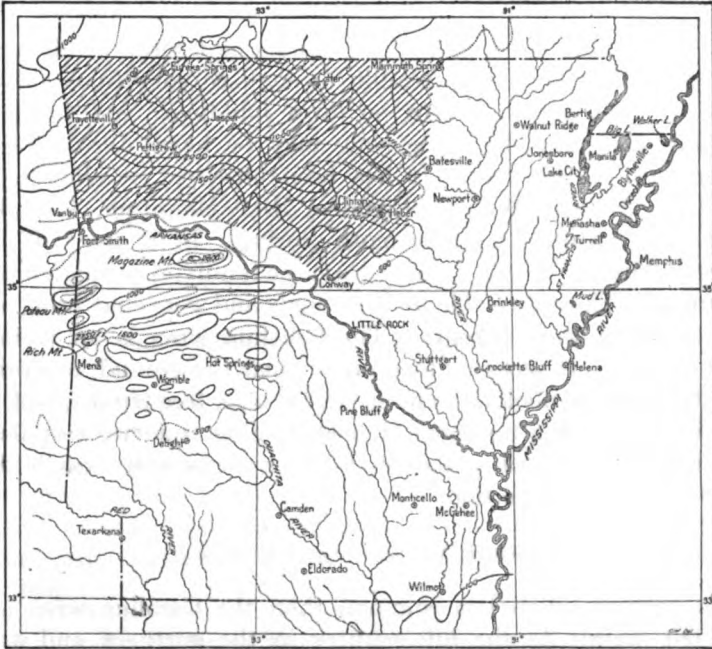


FIG. 4.—Breeding area of the brown thrasher (*Toxostoma rufum*) in Arkansas.

pillars, and grasshoppers. Though sometimes a pest where small fruits are raised, this bird on the whole does more good than harm.

**Brown Thrasher.** *Toxostoma rufum*.

This bird, frequently called the "brown thrush," is a common migrant and a rare summer resident in the northern part of the State. It is reported as nesting at Clinton and Newport, and I found it breeding in small numbers at Conway and Mammoth Spring. At the latter place a nest with young was found June 15. At Helena it does not breed but is reported as a rare migrant, arriving from the south about March 15 (earliest, March 1) and passing south in October and November (last seen, November 13). A few pass the

winter in the State, as at Delight, where they were observed in small numbers by Savage, and at Van Buren, where Hanna saw one bird January 5. Migrants from the north reached Delight September 27 and by October 15 the species was common there. The thrasher is a decidedly useful bird, more than half of its food consisting of injurious insects, such as beetles, grasshoppers, crickets, and caterpillars. In summer it eats some cultivated fruits, mainly raspberries, currants, and cherries, but the damage done is usually inconsiderable. In fall and winter it feeds largely on wild fruits, such as the berries of dogwood, sumac, and poison ivy.

**Carolina Wren.** *Thryothorus ludovicianus.*

The Carolina wren is one of the commonest birds in all parts of Arkansas. It adapts itself readily to civilized conditions and often places its nest about houses or farm buildings, and being non-migratory its cheerful ringing song may be heard throughout the greater part of the year. It has been observed in abundance at Lake City, Helena, Wilmot, Camden, Rich Mountain, Van Buren, Pettigrew, Clinton, and Mammoth Spring. In a tract of heavy timber at Turrell, May 9, I started a large family of young ones from the ground. They were able to fly strongly and were chattering noisily in imitation of their parents. The Carolina wren is an eminently useful species. It seeks its food on or near the ground, exploring in great detail every nook and cranny in old logs, tree trunks, and brush piles, where it finds numbers of beetles, ants, spiders, weevils, and other insects. In such places it destroys many boll weevils during their season of hibernation.

**Bewick Wren.** *Thryomanes bewicki.*

This wren is much less common than the Carolina wren and is restricted mainly to the hill country in the northern and western parts of the State. It is even more domestic in its habits than the preceding and indeed is a characteristic "house wren," taking the place in Arkansas of the common house wren of the Eastern States. It is reported as a rare breeder at Clinton and Newport. I found it in small numbers at Mammoth Spring, Cotter, and Rich Mountain Station (1,600 feet altitude). It is fairly common at Conway and in the valleys about Pettigrew. In the lowlands this bird occurs only as a migrant, recorded from Helena in March and October, and from Lake City May 1 and 2. A few remain throughout the winter in the warmer parts of the State, as at Van Buren, where it was observed by Hanna on January 7. It does not breed at Delight, but appeared there on October 14 and 15 and remained until March 10.

**House Wren.** *Troglodytes ædon parkmani.*

The common house wren of the Northern States occurs in Arkansas only as a migrant. It has been observed infrequently at Helena between April 17 and 29, and at Clinton between April 29 and May 7 and in early November. I saw one individual at Lake City April 29 and one at Turrell May 7. Savage noted a migrating bird at Delight October 2. There is but one winter record from the State, that of H. S. Reynolds, who observed the species at Judsonia.<sup>1</sup> Probably the eastern form (*ædon*) of this species also occurs in the State, but no specimens are available.

**Winter Wren.** *Nannus hiemalis.*

This tiny short-tailed wren is a northern-breeding species and occurs only during migrations and in winter. It is a shy bird, spending its time during its winter sojourn mainly in and about brush piles and hollow logs in the woods. McAtee saw several at Turrell and Menasha in November and Hanna took five specimens at Van Buren in December. It has been observed also at Clinton in April, at Helena in May, and at Delight on October 29. Its stay in the State ordinarily extends from October to the middle of April.

**Short-billed Marsh Wren.** *Cistothorus stellaris.*

This species breeds in the Mississippi Valley from Missouri northward and winters mainly in the Southern States. It occurs as a migrant and possibly as a winter resident. There is but one record of its occurrence in the State—that of a bird which I observed May 17 in a broom sedge field near McGehee. This is an unusually late date, for the spring migration of this wren takes place usually in April or early May.

**Prairie Marsh Wren.** *Telmatodytes palustris iliacus.*

This is the Mississippi Valley form of the common long-billed marsh wren. It is a dweller in wet marshes along the borders of rivers and lakes, where its globular nests are fastened to the upright stalks of cattail flags over the water. In migration it is sometimes found in strange situations, as in the case of one which I caught in the railroad station at Blytheville about 11 p. m., May 5, or of another which I saw in a dry broom sedge field at McGehee, May 17. A single bird shot at Mena May 24 was probably a belated migrant. The species breeds locally in the State, having been observed in summer on the St. Francis River at Lake City and Bertig.

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<sup>1</sup> Am. Nat., XI, p. 307, 1877.

**Brown Creeper.** *Certhia familiaris americana.*

The brown creeper is a common migrant in the Mississippi Valley and a winter resident in the southern part. Since it is known to breed regularly in the Sunken Lands of Southeastern Missouri (Widmann), it will probably be found breeding also in similar situations in northeastern Arkansas. The bird has been observed at Helena and Clinton in April and is reported also from Newport. Savage saw a few the first week of September at Delight and Hanna found the species common at Van Buren in December. It is a quiet, inconspicuous little bird, and seeks its food, mainly insects, on the trunks of trees, up which it creeps in long spirals.

**White-breasted Nuthatch.** *Sitta carolinensis.*

The white-breasted nuthatch is a generally distributed and not uncommon permanent resident. It is an inhabitant of wooded regions, and is perhaps most numerous in the mountains and foothills. It is reported as a breeder at Clinton, Fayetteville, and Newport. I found it in small numbers at Walker Lake, McGehee, Wilmot, Delight, Rich Mountain, Pettigrew, and Mammoth Spring. It is nonmigratory and has been observed in winter at Fayetteville, Judsonia, and Van Buren. At the latter place Hanna took specimens in November, December, and January. The food of this nuthatch in summer consists largely of cankerworms, forest tent caterpillars, plant lice, and other insects. In winter it takes a good many seeds and berries and some nuts.

**Red-breasted Nuthatch.** *Sitta canadensis.*

This species breeds mainly in the Northern States and Canada and winters over most of the United States. It probably occurs in Arkansas as an irregular migrant and winter visitant, but has been recorded only once—by Mrs. Stephenson, at Helena, October 3, 1895.

**Brown-headed Nuthatch.** *Sitta pusilla.*

This little nuthatch is a southern bird, common in the Gulf States and occurring locally as far north as Shannon County, Mo. It has been recorded in Arkansas only once—at Newport,<sup>1</sup> but it will doubtless be found sparingly in other places, particularly in pine-forested regions.

**Tufted Titmouse.** *Baeolophus bicolor.*

The tufted titmouse, or "tomtit," is common and generally distributed in the State, but less numerous in the mountains than in the heavily timbered river bottoms. It has been reported from Fayetteville, Pettigrew, Van Buren, Rich Mountain, Delight, Wilmot, Lake City, Mammoth Spring, Clinton, and Conway, and is a permanent resident wherever found.

<sup>1</sup> Cooke, W. W., Bull. 2, Div. Orn. and Mamm., U. S. Dept. Agric., p. 276, 1888.

In summer the tufted tit feeds largely on insects, as grasshoppers, beetles, cutworms, and caterpillars. In winter it consumes, in addition to insects, a considerable quantity of vegetable food, such as beechnuts, hazelnuts, acorns, chinquapins, and the berries of the dogwood, Virginia creeper, and other wild fruits.

**Carolina Chickadee.** *Parus carolinensis.*

The chickadee is a common bird in nearly all parts of the State, remaining throughout the year. It is much smaller than its relative, the tufted tit, with which it is often found associated, especially in winter. It has been reported from Fayetteville, Fort Smith, Clinton, and Helena. I found it common at Turrell, Wilmot, Womble, Rich Mountain, Cotter, and Mammoth Spring. Hanna collected 16 specimens at Van Buren in November and December. The chickadee is a dweller in both forest and orchard, and is everywhere a valuable aid to the farmer. It destroys large numbers of noxious insects, among them the tent caterpillar, various beetles, and the eggs, larvæ, and chrysalids of moths. About one-third of its food is of vegetable origin, and includes small seeds, the pulp of wild fruit, and wild berries.

**Golden-crowned Kinglet.** *Regulus satrapa.*

This tiny bird, but little larger than a humming bird, is a dweller in the Boreal zone in summer, but in winter is found over most of the eastern United States. Although recorded from only a few localities in Arkansas, it doubtless occurs generally as a migrant and winter resident. H. S. Reynolds records it as wintering at Judsonia,<sup>1</sup> and Hanna found it common at Van Buren in December. Mrs. Stephenson has observed the species a few times at Helena between March 7 and April 25, and Savage saw one bird at Delight on October 23.

**Ruby-crowned Kinglet.** *Regulus calendula.*

Like its cousin, the goldencrown, this kinglet is a northern breeding species and is found in Arkansas only in migration and in winter. It is common at that season in the Sunken Lands (Widmann), and Hanna found it common at Van Buren in December. It has been observed also at Clinton and Helena in January. The spring migration takes place in March and April, and at such times one often hears snatches of its clear sweet song from some thicket in the woods. The last migrants noted at Helena were seen April 29; at Delight it was observed between March 15 and April 25. In the fall the species invades the State during October, having arrived at Delight October 8 and become common there by the 20th of that month.

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<sup>1</sup> Am. Nat., XI, p. 307, 1877.

**Blue-gray Gnatcatcher.** *Poliptila caerulea.*

The gnatcatcher is a common summer resident, particularly in timbered river bottoms and the big swamps of the Sunken Lands. It is reported as a breeder at Clinton, Newport, and Helena, and I found it plentiful at Lake City, Walker Lake, Turrell, Wilmot, Womble, and Mammoth Spring. None were observed on Rich Mountain and only one at Pettigrew. The first arrivals in spring reach Helena about March 15, and the last seen in fall were noted October 28. Nest building sometimes begins by March 30, and by May 1 or sooner the young are hatched. This bird apparently has no special predilection for gnats, as its name seems to suggest, but feeds upon a variety of small Hymenoptera, beetles, flies, caterpillars, and spiders.

**Wood Thrush.** *Hylocichla mustelina.*

The wood thrush is a common summer resident in all parts of the State. As its name indicates, it is a woodland dweller, preferring heavy deciduous forests on the mountains and in river bottoms. The species arrives at Helena from the south about April 10 (earliest record, April 4) and takes its departure in October. The last was seen at Delight October 8. It is reported as breeding at Clinton, Newport, and Helena. I found it numerous at McGehee, Camden, Womble, Rich Mountain, Pettigrew, Chester, and Mammoth Spring. Only a few were observed in the Sunken Lands, but McAtee found them numerous at Big Lake in June, 1911.

The food of this bird consists largely of insects, with a small percentage of fruit. The insects eaten include grasshoppers, crickets, cutworms, ants, caterpillars, and beetles, including the potato beetle. The fruit consumed is chiefly of wild varieties, such as frost grapes, wild blackberries, wild cherries, and the seeds of the spicebush and southern magnolia. Since the wood thrush is a decidedly useful species and adapts itself readily to civilized surroundings, its presence about the farm and garden should always be encouraged.

**Willow Thrush.** *Hylocichla fuscescens salicicola.*

The willow thrush, the western form of the veery, is a common migrant in the Mississippi Valley, breeding from Iowa northward. It is noted by Mrs. Stephenson nearly every spring at Helena between April 18 and May 19, the majority passing north during the first week of May and south during late September and early October. It has been observed also at Clinton and doubtless will be found generally throughout the State during migration. The food of this species is similar to that of the other thrushes, and includes a variety of insects and wild fruits.

**Gray-cheeked Thrush.** *Hylocichla alicia*.

This thrush is an abundant migrant in the Mississippi Valley on its way to and from its breeding grounds in Canada and Alaska. It is one of the latest migrants, reaching Arkansas the last week of April and lingering sometimes till late in May. It passes south in late September and October, Mrs. Stephenson having observed one at Helena as late as October 10. I noted the species in small numbers at Turrell (May 10), Stuttgart (May 13), Arkansas City (May 15), and McGehee (May 17). During its spring sojourn, this bird feeds chiefly on insects, but in the fall it prefers wild fruits and berries, such as sour gum, dogwood, poke berries, and frost grapes.

**Olive-backed Thrush.** *Hylocichla ustulata swainsoni*.

This is another of the northern breeding thrushes, occurring abundantly in migration in the United States. It resembles the graycheek closely in general appearance and is with difficulty distinguished from it in the field. It arrives in Arkansas usually by the middle of April, becoming common by the first of May and remaining till the 10th or 15th of that month. Mrs. Stephenson has observed it at Helena between April 30 and May 4, and Mr. Savage has noted it at Delight between April 15 and May 2. I found it common at Lake City and Turrell from April 29 to May 10. The southward movement takes place chiefly in late September and October, although occasionally a few birds linger till November, as in 1889, when the last were seen at Clinton November 15.

**Hermit Thrush.** *Hylocichla guttata pallasi*.

The hermit thrush is the hardiest of its family and often spends the winter in the United States as far north as Missouri. It nests in the Northern States and Canada, and is an abundant bird in Arkansas in migration, the majority passing northward in April and southward in October. It rarely sings while migrating, but on its breeding grounds it is famed for its beautiful song. The species has been recorded as occurring in winter in small numbers at Judsonia,<sup>1</sup> Stuttgart (Hollister), and Delight. Hanna took one specimen at Van Buren December 10. It is given as a migrant at Clinton and Helena.

In spring and summer the hermit thrush feeds mainly on insects, but in fall and winter it partakes largely of various wild fruits and berries, such as frost grapes, pokeberries, and the fruit of the dogwood, cedar, holly, and sumac.

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<sup>1</sup> Reynolds, H. S., *Am. Nat.*, XI, p. 307, 1877.

**Robin.** *Planesticus migratorius migratorius.*

The robin is an abundant migrant and a common winter resident but occurs in summer only in the northern part of the State and nowhere very commonly. It is reported as breeding rarely at Clinton and Newport, and I found it in small numbers at Pettigrew, Chester, Conway, and Mammoth Spring. It is reported also from Hot Springs, but must be very rare, as I saw none in the mountains west of there in Montgomery and Polk Counties. Mrs. Stephenson states that only once has a pair remained during the summer at Helena. Young birds were seen at Delight in July, probably stragglers from their nesting grounds farther north. In winter it occurs in roving flocks, having been reported from Stuttgart (Hollister), Fayetteville, Judsonia, Turrell, Clinton, Helena, and Van Buren (rare). Breeding specimens of the northern form have been examined from Mammoth Spring and one winter specimen from Van Buren. Nearly half the robin's food for the entire year consists of insects, mainly beetles, grasshoppers, and caterpillars. The remainder is made up chiefly of wild fruits, which are eaten extensively during the fall and winter months and to a less extent at other seasons. In early summer, robins take considerable cultivated fruit, particularly cherries, but the damage done is rarely sufficient to warrant the wholesale destruction of the birds. The wild fruits eaten include cherries, grapes, huckleberries, hackberries, persimmons, and the fruit of the sumac, dogwood, greenbrier, holly, and elder.

**Southern Robin.** *Planesticus migratorius achrusterus.*

The southern form of the robin is probably of accidental occurrence in Arkansas. The only record from the State is that of a single bird taken by Mr. G. Dallas Hanna at Van Buren, December 17, 1910.

**Bluebird.** *Sialia sialis.*

The familiar bluebird is abundant in both summer and winter. It nests in hollow trees or fence posts, but is domestic in its habits, and readily adopts for its use nest boxes placed on poles or about farm buildings. It is reported as breeding at Fayetteville, Clinton, Newport, and Helena. I found it common at practically every locality visited, including Lake City, Wilmot, Eldorado, Rich Mountain, Pettigrew, and Conway. In winter it is reported as abundant at Paragould,<sup>1</sup> Fayetteville, Helena, Judsonia (Reynolds), and Van Buren. A study of the food habits of this bird has shown it to be highly beneficial. Three-fourths of its food consists of insects, mainly beetles, grasshoppers, and caterpillars. Practically no cultivated fruit is eaten, but a great variety of seeds and wild berries, such as blackberries, cedar berries, and chokeberries, and seeds of the greenbrier, Virginia creeper, holly, mistletoe, and sumac.<sup>2</sup>

<sup>1</sup> Gault, B. T., *Nidologist*, III, p. 84, 1896.

<sup>2</sup> Beal, F. E. L., *Farmers' Bul.* 54, U. S. Dept. Agric., pp. 46, 47, 1904.

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HENRY W. HENSHAW, *Chief*

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# WOODPECKERS IN RELATION TO TREES AND WOOD PRODUCTS

BY

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## LETTER OF TRANSMITTAL.

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U. S. DEPARTMENT OF AGRICULTURE,  
BUREAU OF BIOLOGICAL SURVEY,  
*Washington, D. C., May 24, 1911.*

SIR: I have the honor to transmit herewith, for publication as Bulletin No. 39 of the Biological Survey, a report on Woodpeckers in Relation to Trees and Wood Products, by W. L. McAtee, assistant, Biological Survey. Woodpeckers as a family take high rank among our insectivorous birds, and being specially equipped to dig into wood for hidden larvæ inaccessible to other birds aid materially in the conservation of our forests. Three members of the group, however, the only ones properly known as sapsuckers, are injurious, since their chief purpose in digging into trees is to secure the cambium and the sap for food. The holes they make also permit entrance of moisture, bacteria, and fungi which injure and sometimes destroy the tree. They also cause staining of the wood, seriously impairing its market value when converted into lumber. Altogether the damage done by sapsuckers in the United States amounts yearly to not less than \$1,200,000. This bulletin treats of the more strictly economic aspects of woodpecker work, and points out wherein the birds are beneficial and wherein injurious, and in the latter case suggests remedies.

Respectfully,

HENRY W. HENSHAW,  
*Chief, Biological Survey.*

HON. JAMES WILSON,  
*Secretary of Agriculture.*



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# WOODPECKERS IN RELATION TO TREES AND WOOD PRODUCTS.

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## INTRODUCTION.

Woodpeckers are peculiarly dependent upon trees, which furnish them food, shelter, and cradles for their young. No birds are more highly specialized nor more perfectly adapted to a particular mode of life than are most woodpeckers to arboreal existence. Moreover, as trees are important to woodpeckers, so are these birds important to trees. Woodpeckers benefit trees by consuming many of the most destructive forest pests, insects largely inaccessible to other birds. In securing these insects, however, which constitute the bulk of their food, and in making nests and shelter cavities, woodpeckers have another significant economic relation to trees, for they remove bark and wood from both dead and living trees. In the case of dead trees little or no harm is done. When, however, they make excavations in living trees, the birds destroy more or less of the cambium layer, from which proceeds the growth of both wood and bark. Slight injuries to the cambium result in distorted growth, but the destruction of large areas may cause death. Since trees are exceedingly valuable to man, the habits of birds whose relations to trees are so vital are of much economic importance.

It is the purpose of this bulletin to examine the evidence for and against woodpeckers and to determine their status according to the effect of their habits upon trees and wood products. Injuries by woodpeckers are treated under two heads: (1) Damage by woodpeckers in general; (2) injuries due almost exclusively to the three species properly known as sapsuckers.

## DAMAGE BY WOODPECKERS IN GENERAL.

This topic may be divided into two sections: Damage to trees, and damage to wooden posts and structures.

## DAMAGE TO TREES.

Primarily the work of woodpeckers on the living parts of trees is injurious. The important cambium layer is injured every time a nest is excavated or an insect dug out. To what extent the various

injuries are offset by beneficial activities of the birds will be discussed later.

#### HOLES MADE IN DIGGING OUT INSECTS.

As a rule the holes made by woodpeckers when digging out insects are not large, and there is every reason to believe that most of them heal quickly without noticeably disfiguring the exterior of the trees. They cause distortion and staining of the wood, however, as do all injuries to the cambium. These defects often resemble those which result from sapsucker work, but they generally occur in otherwise unsound trees and are much less numerous and important. However, wounds made by woodpeckers when digging out borers deeply buried in the wood, by reason of their larger size, often result in bleaching the wood (see Pl. III, fig. 6), a feature rarely observed in connection with the smaller sapsucker pecks.

Our two largest species of woodpeckers, the pileated and the ivory-billed, dig great pits or furrows in living trees or split off large chips. Plate III, figures 1 to 5, illustrates large wounds made by pileated woodpeckers. F. M. Chapman says: "I have seen an opening made by a pileated woodpecker in a white-pine tree 12 inches long, 4 inches wide, and 8 inches deep, through perfectly sound wood to reach the larvæ at work in the heart of the tree."<sup>1</sup> These large woodpeckers occasionally riddle trees which show no signs of insect attack, but this is so unusual as not to warrant hostility toward these fine birds, which are disappearing only too rapidly as man encroaches upon their domain.

All woodpeckers chip off considerable wood from dead trees and branches to secure the insects therein. In spite of the good done by destroying these insects, in some countries woodpeckers are held in disrepute because they reduce the quantity of firewood, a view not likely to be adopted in the United States.

Indeed, the offices of woodpeckers in capturing the various wood-boring insects may be likened to those of the surgeon who removes diseased parts from the human body. Not only do we deem the surgeon's achievement praiseworthy, but we pay him well for doing it. We should maintain the same attitude toward the woodpeckers, surgeons to our trees. Practically all the compensation they demand is the privilege of excavating nests and sleeping shelters in trees.

#### EXCAVATION OF NEST AND SHELTER CAVITIES.

There are 24 species (and several subspecies) of woodpeckers in the United States, and although most of them usually select dead stubs or limbs or partly decayed trees in which to make their nests,

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<sup>1</sup> Chapman, F. M., *Color Key to N. A. Birds*, p. 148, 1903.

nearly all of them at times choose living trees. Some use living trees almost exclusively and dig a new hole each year; others occupy the same nest year after year. The Williamson sapsucker is one of the species which habitually nest in living trees. Joseph Grinnell relates that in the San Bernardino Mountains tamarack or lodge-pole pines (*Pinus murrayana*) are selected by that species as nest trees, usually old ones with the core dead and rotten but with a live shell. In one tree he noted a series of 47 holes which penetrated the trunk on all sides up to about 35 feet. Besides these there were many smaller drillings. When once selected by these sapsuckers a tree is doomed, but probably not more than 1 tree in 500 is appropriated by the birds.<sup>1</sup>

#### ATTACKS OF TREE ENEMIES AIDED BY WOODPECKERS.

Unlike the surgeons of the human body, woodpeckers neither close the wounds they make nor apply antiseptic treatment, but leave the cuts open to infection. Hence an opportunity is given for a host of enemies, such as bacteria, fungi, and insects, to enter the wound and further injure the tree. While the birds are at fault in so far as they create conditions allowing the inception of damage by these formidable tree enemies, it is evident that blame for all the ensuing injury can not be placed upon them, and it must be admitted that insects, fungi, and bacteria do immense damage with which woodpeckers are in no way connected. It should not be overlooked, however, that old woodpecker holes are of use also to many friends of trees, as they furnish nesting sites for bluebirds, titmice, chickadees, and other insectivorous birds.

#### COMPENSATION FOR INJURIES DUE TO FOOD AND NEST EXCAVATIONS.

After all, however, the question to be decided in regard to the injuries incident to insect hunting and nest excavating by woodpeckers is: Do the services the birds render in destroying the enemies of trees outweigh the damage they inflict? In Bulletin 37 of the Biological Survey it is shown that most woodpeckers destroy vast numbers of the worst pests of trees, many of which are inaccessible to other birds.

This service by no means exonerates those species properly called sapsuckers, nor does it free from blame woodpeckers which attack structures valuable to man. It does mean, however, that in general we can safely ignore the minor injuries committed by woodpeckers in pursuance of their natural mode of life, and that in practically all cases (with the exceptions noted) woodpeckers living in forests, groves, or orchards do a great deal more good than harm.

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<sup>1</sup> Grinnell, Joseph, Univ. Calif. Pub. Zool., V, 64-65, 1908.

**DAMAGE TO WOODEN POSTS AND STRUCTURES.**

However, when woodpeckers depart from their normal activities and inflict injuries in no wise essential to securing sufficient food or proper shelter, we are not bound to pass over the offenses so lightly as those above discussed. Probably the most serious damage resulting from a change of habits is the hollowing out of telephone poles for nest or shelter cavities, so weakening them that they snap off in high winds.

**DAMAGE TO TELEPHONE AND TELEGRAPH POLES.**

The red-headed woodpecker (*Melanerpes erythrocephalus*) in some sections commonly chooses telephone poles as nesting sites. The Pennsylvania Telephone Co., of Harrisburg, reports that some years ago many costly poles were destroyed by this species, and Mr. Howard F. Weiss, of the Forest Service, states that 110 out of 268 white cedar poles along a southern railway were bored by this bird. The bird once became a nuisance to the Kansas City (Mo.) Electric Car Co. by drilling the poles carrying the feed cables. A man employed to kill them destroyed 19 in one day.<sup>1</sup>

A related species, the golden-fronted woodpecker (*Centurus aurifrons*), does similar injury in Texas. Mr. H. P. Attwater says: "Here their favorite nesting sites are in telegraph poles, and there are few that are without woodpecker holes, as they appear to make new ones every year. . . . A line running out of San Antonio to a ranch 9 miles distant was almost destroyed by these birds. They came from all sides, from far and near, and made fresh holes every year, sometimes as many as five or six in a single pole."<sup>2</sup>

Sennett made similar observations on the same bird in the Rio Grande Valley. He says: "The square Government telegraph poles are its favorite nesting place. There is hardly a pole free from their holes, and in one I counted ten; probably some were made by their only relative of that section, *Picus scalaris*, Texas woodpecker."<sup>3</sup>

Farther west a woodpecker, probably the Gila woodpecker (*Centurus uropygialis*), has been a source of trouble and expense to the Southern Pacific Co. for several years, especially along the 200 miles of road between Benson, Ariz., and Guaymas, Mexico. Mr. C. T. Day, assistant superintendent of telegraph on the Sonora division of this railway, says that between Nogales and Guaymas, Sonora, a great many poles have been lost on account of woodpeckers. "We are

<sup>1</sup> Bryant, J. A., Osprey, I., 147, Aug., 1897.

<sup>2</sup> Quoted by Bendire, C., Life Histories of N. A. Birds, II, 125, 1895.

<sup>3</sup> Sennett, Geo. B., Notes on the Ornithology of the Lower Rio Grande of Texas. Bull. U. S. Geol. and Geog. Survey Terr., IV, 39, 1878.

now changing some 300 poles on this account," he writes. The poles injured "are round cedar, square redwood, and also round creosoted poles; the latter were only placed within the line within the last two or three years. The square poles seem to suffer the most; in many cases we find five or six holes of 3 or 4 inches in diameter in one pole. It seems to be the object of the woodpeckers to dig into the pole for insect life, which the pole may contain, although we find places where they have made nests. The hum of the wires, I think, has something to do with attracting the birds to the poles, which sound they take to be insect life in the pole." (Aug. 17, 1910.)

Besides the species already mentioned, the following are known to injure telephone poles to a greater or less degree: Texan woodpecker (*Dryobates s. bairdi*), St. Lucas woodpecker (*Dryobates s. lucasanus*), California woodpecker (*Melanerpes f. bairdi*), red-bellied woodpecker (*Centurus carolinus*), yellow-shafted flicker (*Colaptes auratus*), and red-shafted flicker (*Colaptes c. collaris*). The California woodpecker, besides making nest cavities, perforates the entire surface of poles with small holes in which to store nuts. (See Pl. IV, fig. 1.) However, "decay is the great cause of destruction of poles. It is estimated that approximately 95 per cent are destroyed by this cause and only 5 per cent by breakage or mechanical abrasion."<sup>1</sup> How much of the breakage is due to the weakening of posts by woodpeckers is unknown, but the damage is nowhere near as great as commonly supposed. Mr. Howard F. Weiss, of the Forest Service, discusses the effects of woodpecker attack on poles, in the Engineering News of February 23, 1911 (vol. 65, No. 8, p. 220), from which we quote at length:

The number of holes in each pole may vary from one to a dozen or more, although these larger numbers are not common. The size of the hole varies from about  $\frac{1}{4}$  to 3 inches diameter. When used for nesting sites the birds may hollow out a pocket 6 to 10 inches in diameter and a foot or more in depth.

The question of interest to telephone engineers is to just what extent such poles are weakened. The following example may be of interest. It has been found from measurements on two hundred and fifty 30-foot northern white-cedar poles that their average taper is approximately as follows:

Circumference (inches).	Distance from butt (feet).
43.....	0
37.....	5
36.....	6
34.....	10
32.....	15
29.....	20
27.....	25
24.....	30

<sup>1</sup> Bureau of Census, Forest Products, No. 10, p. 106, 1909.

Assuming the pole as a cantilever, loaded at one end, it is found that it may be hollowed to the extent shown in the figure without decreasing its strength. The length of ordinate between shaded area and right-hand edge of the diagram represents the thickness of outer shell which must be sound. For example, at 10 feet from the ground if only 2 inches of the outer shell are left, the pole will be approximately as strong as though it were solid. This grants the bird permission to build a house

about 6 inches in diameter. The higher up the pole it goes the larger can be its nest without injury. If, however, the attack is less than 4 feet from the ground the pole will be appreciably weakened.

This illustration neglects the damage done by the entrance into the pole, or the subsequent decay which may follow, and assumes that the bird builds its nest exactly in the center—a condition not always found in fact. On the other hand, it assumes that the pole has a uniform moisture per cent throughout its length and that the outer fibers at the ground line are perfectly sound. These conditions seldom, if ever, exist in practice, as the pole, particularly if it has been set for a year or more, always contains more moisture near the ground than at any point above it, and the sapwood at the ground is invariably more or less decayed. Hence, the birds could peck even larger holes than those shown in the sketch without increasing their damage.

The engineering department of the American Telephone & Telegraph Co. made a few tests in 1908 near Zanesville, Ohio, to determine the effect of woodpecker attacks upon the strength of poles. These tests were made by fastening a rope around the top of the pole and pulling with a block and tackle to which a dynamometer

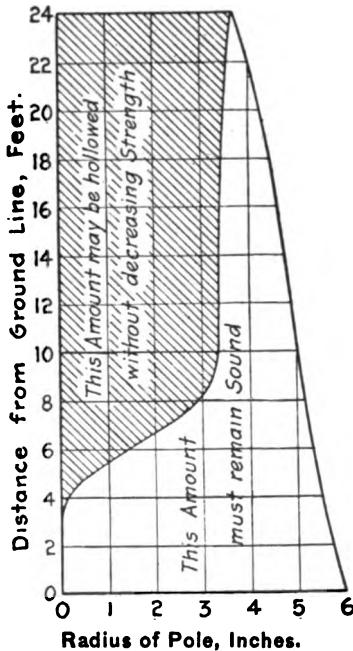


Diagram showing the extent to which a pole can be hollowed by birds without appreciably decreasing its strength.

eter was attached. In 9 cases out of 12 the poles broke at the ground line and not at the points attacked by the birds. The examples in the accompanying table are typical.

*Typical results of tests of damaged poles; American Telephone & Telegraph Co., Zanesville, Ohio.*

	Pole No. 6390.	Pole No. 6325.	Pole No. 6372.
Material.....	Cedar.....	Cedar.....	Cedar.....
Wires.....	44.....	44.....	44.....
Length.....	35 feet.....	35 feet.....	35 feet.....
Circumference, at ground (original).....	43½ inches.....	42½ inches.....	40½ inches.....
Circumference below ground (minimum).....	38½ inches.....	42 inches.....	38 inches.....
Circumference, point of load.....	31 inches.....	31½ inches.....	27 inches.....
Diameter bird hole.....	6 inches.....	8 inches.....	(See note.)
Distance of hole above ground.....	9 feet 6 inches.....	24 feet.....	
Distance of load point above ground.....	25 feet.....	26 feet.....	
Broke off at.....	Ground.....		Ground.....
Under corrected load.....	520 pounds.....		1,100 pounds.....
Set in.....	Earth.....	Rock.....	Earth.....
Top reflection (maximum).....	2 feet 11 inches.....	5 feet 7 inches.....	
Butt reflection (maximum).....	1 foot 3 inches.....	5 inches.....	
Estimated breaking weight.....	1,200 pounds.....	3,000 pounds.....	2,000 pounds.....

After pole No. 6390 broke as above shown it was reset and tested as a 30-foot pole, and it broke at the new ground line ( $40\frac{1}{2}$  inches circumference) under 1,000 pounds corrected load. It had a  $2\frac{1}{2}$ -inch shell at break. Estimated breaking weight as a 30-foot pole, 2,500 pounds.

Pole No. 6325 was sound at the ground and set in wet rock hole, with about 10 inches of clay on top. At 3,000 pounds, actual reading, the dynamometer slipped. The load was applied for 300 pounds more, when the rope broke and test was abandoned.

Pole No. 6372, at 1,100 pounds, corrected load, gave way at ground, but did not quite break off. There were 10 woodpecker holes between 15 and 20 feet above ground, as follows:

13 feet above ground..... 3 by 3 inches, 4 inches deep.

17 feet above ground..... 3 by 3 inches, 5 inches deep.

18 feet above ground..... 3 by 3 inches, 3 inches deep.

19 feet above ground..... 3 by 3 inches, 5 inches deep.

At fifth gain, 30-inch circumference, 6 smaller holes.

It appears, therefore, that the attack of poles by these birds is not as serious as one would be prone to believe, and, taking into account the great good that they do in eating insects, the destruction of our feathered friends can by no means be justified by the injury they do to pole-line construction.

#### DAMAGE TO FENCES AND BUILDINGS.

The downy, hairy, Texas, California, and red-headed woodpeckers and both the yellow-shafted and the red-shafted flicker are known to excavate holes in fence and gate posts, but the loss is much less than in case of telephone poles. Indeed, it is probable that in most cases where woodpeckers nest in fence posts about yards and farms the owner is glad to have them there because of the number of insects they destroy. To say the least, it would be an advantage to have them nest in fence posts rather than orchard trees, for instance, and they would still visit the trees to glean insects.

As woodpeckers excavate poles and fence posts, it is not surprising that they attack other wooden structures. The usual type of injury of this class is drilling holes into cornices or under eaves of houses or piercing the walls of barns and sheds.

Buildings that are unoccupied most of the time, as schoolhouses and churches, are frequently defaced, church towers or steeples being favorite points of attack. The red-headed woodpecker is an old offender in this respect, and a case is recorded<sup>1</sup> where in one season 22 of these birds were killed one after another while attempting to make a nest in a church steeple. During the caretaker's absence a pair finally completed a nest and reared their young. The red-bellied woodpecker also sometimes makes holes in houses, but the flickers—the yellow-shafted in the East and the red-shafted in the West—are the woodpeckers that show the strongest predilection for boring into buildings. Often many holes are made in the same wall. (Pl. V, fig. 1.) Apparently the birds learn little by experience, but keep on drilling

<sup>1</sup> Stroop, L. J., *American Naturalist*, IV, 692, 1870.

openings into large cavities unsuited for either nests or shelter. When occupied houses are attacked, the loud calls and racket made by the birds, especially in the early morning, are very annoying to the inmates.

The California woodpecker (*Melanerpes f. bairdi*), besides making holes in houses for nests or sleeping quarters, also pecks in cornices a multitude of small holes, wherein acorns are wedged. The bird usually stores the mast in dead limbs of trees, but when acorns abound near buildings it naturally takes advantage of the large exposed surface of dead wood as exactly suited to its purposes. This hoarding instinct undoubtedly has for its basis the provision of food for future use, but the woodpeckers store up immense quantities of acorns which they never eat, most of which fall to the lot of the squirrels and jays.

H. W. Henshaw found the California woodpecker making much use of buildings for storage purposes near Ukiah, Mendocino County, Cal. He was informed that one schoolhouse (Pl. IV, fig. 2) was so much injured in a season or two that it was replaced by a new building in preference to making the necessary repairs.

#### PREVENTION OF DAMAGE BY WOODPECKERS.

The prevention of damage by woodpeckers (except sapsuckers) rarely necessitates destruction of the birds. Moreover, woodpeckers are so valuable as conservators of trees that the public should not be deprived of their services.

It has been claimed that creosote insures telegraph poles against the attacks of woodpeckers, but Mr. Weiss presents evidence to the contrary in the paper previously quoted from (pp. 11-13), and Mr. C. T. Day says concerning results in Sonora:

Some of the creosoted poles about 9 or 10 inches in diameter have been picked, leaving an outside shell. In two or three instances the linesmen have found the inside of poles entirely eaten away . . . and found birds' nests inside. It is a common expression with the linesmen that the woodpeckers get fat on creosote. We tried spraying with carbolic acid in places where their holes were just begun, but so far we have been unable to notice any difference. We are now substituting a Texas pine pole, burnetized, with a creosoted butt, which is claimed to be so much harder than creosote that birds will have considerable difficulty in getting into it. We have some 200 poles up, but as yet they do not show any marks.

The results of experiments of this kind will be awaited with interest. It will be fortunate, indeed, if some one or other of the preservative treatments which are applied to nearly all poles now being set is found to protect them from woodpeckers. As telegraph poles are usually perforated by woodpeckers for the purpose of securing nesting sites, the providing of nest boxes may prove a comparatively cheap and easy solution of the difficulty. If nest boxes be supplied and

utilized by the birds, the poles should be reasonably exempt from attack. Those suitable for woodpeckers (similar to that illustrated by figs. 1 and 2) cost 25 cents each in lots of 20 or more. They may be used to protect trees, fence posts, and buildings, as well as telegraph and telephone poles.

Among native species flickers and the golden-fronted and red-headed woodpeckers have been known to use nest boxes, but few trials of them have been made in the United States. However, such



FIG. 1.—Homemade nest box for woodpeckers.



FIG. 2.—Longitudinal section of nest box shown in figure 1.

experiments have proved very successful in Europe, as the following account of their utility in Germany, where they have been employed extensively, shows:

Wherever these nesting boxes have been hung up, great success has been the result. All the breeders in holes . . . have inhabited them. . . . Ninety per cent of the 2,000 boxes in the wood at Kammerforst . . . and nearly all of the Seebach and of the 2,100 near Cassel were occupied. . . . The Prussian board of agriculture has caused extensive experiments to be made with these boxes, with excellent results. Of the 9,300 boxes hung up by the Government in the State and communal woods of the Grand Duchy of Hesse, 70 to 80 per cent were used the first year, and all have been inhabited this year (1907).<sup>1</sup>

<sup>1</sup> Helsemann, M., *How to Attract and Protect Wild Birds*, pp. 45-46, 1908.

It is sometimes practicable to prevent damage by woodpeckers by covering objects with tin. This does not apply to buildings, of course, and when injury continues despite nest boxes and other protective devices more strenuous action is permissible. Do not try to kill the offenders by putting out poisoned food or water, for you will kill more friends than enemies. Some States properly permit the shooting of birds by the owners of premises that are manifestly being damaged. Shooting should be allowed only when actual damage is being done and then only under supervision of a proper authority.

### DAMAGE BY SAPSUCKERS.

#### DISTRIBUTION AND HABITS OF SAPSUCKERS.

Many woodpeckers are commonly termed sapsuckers, but there are only three species properly so called: The yellow-bellied sapsucker (*Sphyrapicus varius*) (Pl. I), the red-breasted sapsucker (*Sphyrapicus ruber*) (Pl. I), and the Williamson sapsucker (*Sphyrapicus thyroideus*) (Pl. II). The yellow-bellied sapsucker (known also as red-throated sapsucker, squealing woodpecker, and whining woodpecker) together with its western form, the red-naped sapsucker (*Sphyrapicus varius nuchalis*), ranges over practically the whole of North America up to 60° north latitude, breeding from the northern limits of the range south to Massachusetts, Indiana, Colorado, and throughout the Rocky Mountain region, and migrating over the remainder of the continent as far as the West Indies and Central America. It sometimes winters as far north as the southern boundary of the breeding area. The red-breasted sapsucker, locally called the red-headed woodpecker, nests from northern Lower California through the Sierra and Cascade Mountain Ranges to southern Alaska, withdrawing in winter to that part of its range south of middle California. The Williamson sapsucker, the male of which was long known as the black-breasted and the female as the brown-headed woodpecker, occupies in summer the higher parts of the country from the eastern slopes of the Rocky Mountains to the Pacific coast, from Arizona and New Mexico to southern British Columbia, and winters from Texas and southern California south through the greater part of Mexico.

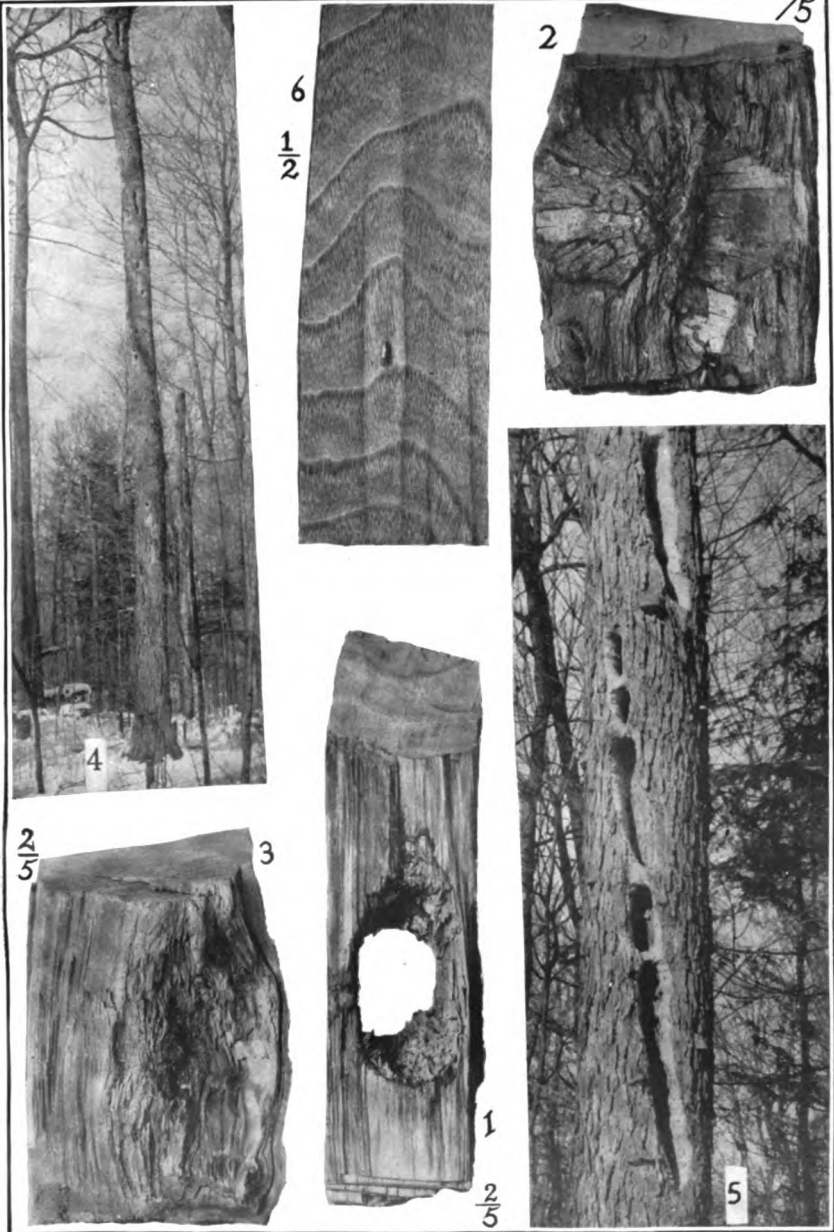
The sapsuckers are a distinctly marked group of woodpeckers and are held by some authorities to constitute a separate subfamily. Most woodpeckers have long tongues which can be thrust far out of the beak and which are armed at the tip with backward projecting spines (fig. 3), enabling the birds to secure their insect prey although deeply buried in wood. The sapsuckers, on the contrary, have short, practically nonextensible tongues, furnished with a fringe of stiff hairs (fig. 4), not adapted to the capture of wood-boring insects.



WILLIAMSON SAPSUCKER.  
[Left figure, female; right, male.]



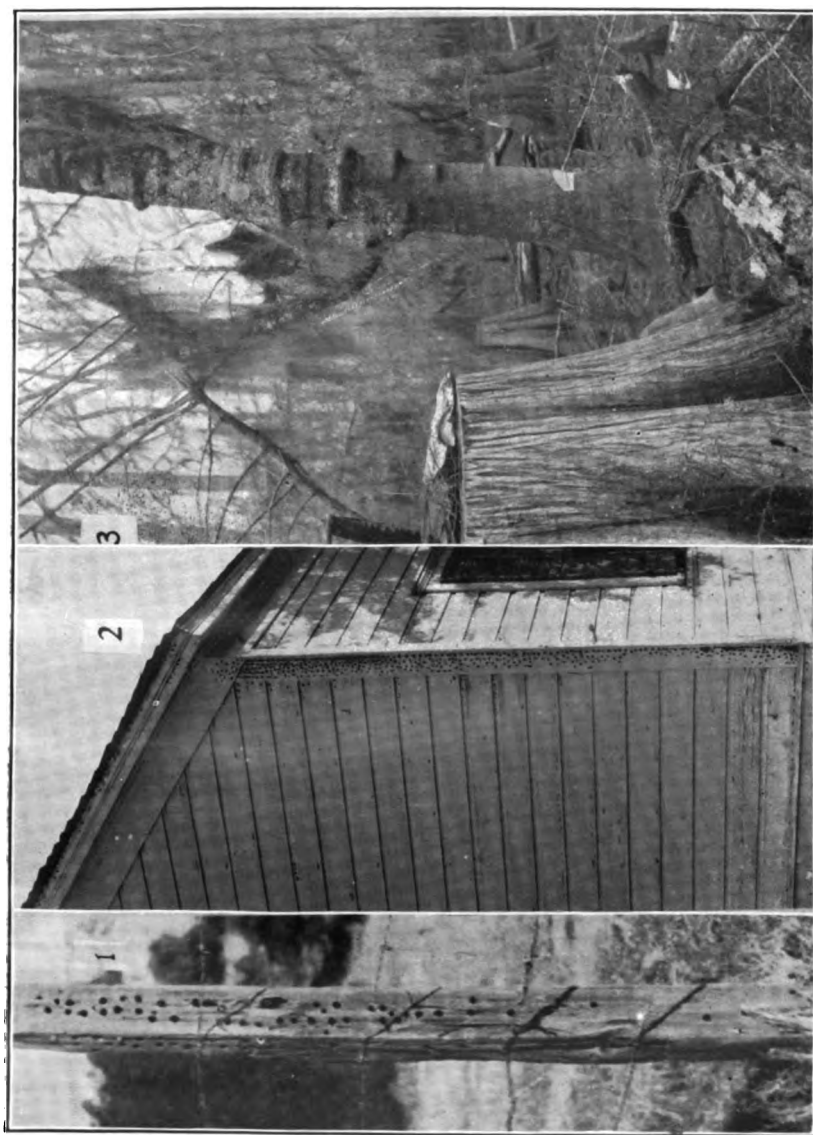
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WORK OF PILEATED WOODPECKER; BLEACHED WALNUT WOOD.

[1, Hole made in canoe cedar (*Thuja plicata*) by pileated woodpecker in search of insects. 2, Healed excavation in same wood, outside view. 3, Same, inside view. 4 and 5, Excavations by pileated woodpecker in dead deciduous trees, Vilas County, Wis. By H. S. Barber. 6, Bleached streak in black walnut, caused by woodpecker's food excavation.]

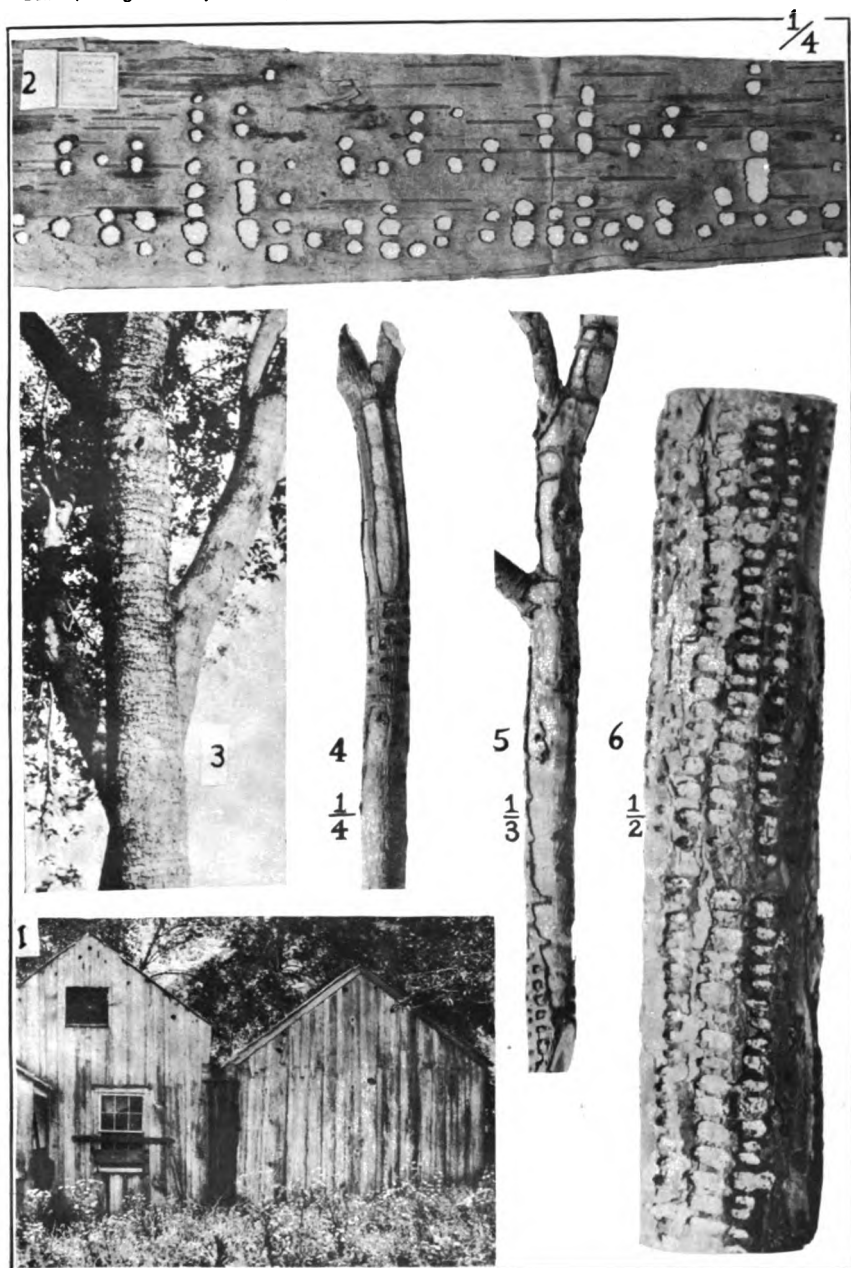




WORK OF CALIFORNIA WOODPECKER; SWOLLEN SAPSUCKER GIRDLES.

[1, Storage holes of California woodpecker in fence post, Sierra foothills, California. 2, Schoolhouse, near Ukiah, Mendocino County, Cal. 3, Swollen girdles produced by sapsucker work on honey locust.]





WORK OF FLICKER AND SAPSUCKERS.

[1, Holes made by flicker in ranch buildings near Haywards, Cal. 2, Type of sapsucker work on white birch; 3, on apple; 4, on willow (*Salix cordata*), holes enlarged vertically by continued excavation at upper end; 5, on willow, almost complete barking; 6, on pitch pine, tree killed.]



In keeping with their peculiarities of structure, these brush-tongued woodpeckers have peculiar food habits. They are the true sapsucking and cambium-eating species. They girdle and kill many trees, either by destroying extensive areas of the cambium or more commonly by removing many small pieces in such a way as to sever most if not all the channels carrying the elaborated sap from which both wood and bark are formed.

The three species are probably equally to blame. While it has been asserted that the red-breasted and Williamson sapsuckers harm trees less than the yellow-bellied, these statements are probably founded on insufficient information. There is a dearth of data respecting the habits of



FIG. 3.—Spiny tongue of downy woodpecker (*Dryobates pubescens*). (From Lucas, Rept. U. S. Nat. Mus., 1895.)

these two woodpeckers, but similarity of structure and the evidence of stomach examinations indicate that the three species of sapsuckers are much alike in their cambium-eating habits and hence all three are injurious to trees. The Williamson sapsucker, however, is strictly an inhabitant of pine forests and aspen groves at considerable elevations, and therefore under present conditions is not likely to injure trees of great value to man.

Stomach examinations show that the red-breasted sapsucker consumes enough cambium and bast to average 12.16 per cent of its food. The same food constitutes 12.55 per cent of the stomach contents of the Williamson sapsuckers examined and 16.71 per cent of the yellow-bellied woodpecker's diet, an average amount for the three of 13.8 per cent. It must be



FIG. 4.—Brushy tongue of sapsucker (*Sphyrapicus varius*). (From Lucas, Rept. U. S. Nat. Mus., 1895.)

noted also that cambium is a very delicate, perishable material, at certain times no more than a jelly, and thus never receives a percentage valuation in examinations of long-preserved stomachs corresponding to its bulk when first swallowed. Neither do we get any record of the sap consumed by these birds, and they are inordinate tipplers.<sup>1</sup> Hence the value of the percentages cited lies not so much in their accuracy as to the quantity of cambium eaten as in the fact that they indicate a steady consumption of this important substance. There

<sup>1</sup> A yellow-bellied sapsucker has been observed to remain within a yard of some of its holes in a maple tree, drinking the sap at frequent intervals, from 10 a. m. to 5 p. m.

is no doubt that cambium, bast, and sap are depended upon by sapsuckers as staple diet.

The results of sapsucker attacks on trees are so uniform and characteristic as to be distinguished easily from the work of other woodpeckers. Sapsucker holes are drilled clear through the bark and cambium and often into the wood. They vary in outline from circular to squarish elliptical, in the latter case usually having the longer diameter across the limb or trunk. Generally they are arranged in rings or partial rings around the trunk, but they often fall into vertical series. Deeply-cut holes arranged with such regularity are made only by sapsuckers.

After the original pattern of holes is completed, the sapsuckers often continue their work, taking out the bark between holes until sometimes large areas are cleanly removed. This often occurs on small limbs or trunks, where long strips of bark up and down the tree are removed, leaving narrow strings between. This effect is also produced by continually enlarging single punctures by excavating at the upper end (Pl. V, fig. 4), which is done to secure fresh inner bark and a constant supply of sap. Occasionally, after a tree has been checkered or grooved after the above-described systematic methods, it may be barked indiscriminately, leaving only ragged patches of bark. (Pl. V, fig. 5.) Even in such cases, however, traces of the regularly arranged punctures are likely to remain, and there is no difficulty in recognizing the work as that of sapsuckers, for no other woodpecker makes anything like it on sound, living trees.

All holes, grooves, or irregular openings made by sapsuckers penetrate at least to the outermost layer of sapwood or nongrowing part of the tree. This results in the removal of the exterior rough bark, the delicate inner bark or bast, and the cambium. Since the elaborated sap (upon which the growth of trees depends) is conveyed and stored in these layers, it is evident that sapsuckers attack the trees in a vital part. Each ring of punctures severs at its particular level part of the sap-carrying vessels, another ring made above destroys others, and so the process continues until in extreme cases circulation of elaborated sap stops and the tree dies. When the injury to the vital tissues is not carried so far, only a limb here and there may die, or the tree may only have its vitality lowered for a few years. If the attacks cease, it may completely recover.

#### **EFFECTS OF SAPSUCKER WORK ON THE EXTERNAL APPEARANCE OF TREES.**

Recovery, however, does not mean that the tree has escaped permanent injury. Patches of cambium of varying size may be killed. Growth ceases at these points and the dead and discolored areas are

finally covered by wood and bark. Until this process is completed, the tree is disfigured by pits with dead bark and wood at the bottom, and even when completely healed, the spot remains a source of weakness. In fact, all sapsucker pecking is followed by more or less rotting and consequent weakening of the wood, and renders trees more liable to be broken by the wind or other causes.

Sapsucker injuries usually stimulate growth of the wood layers at the points attacked, so that they become much thicker than usual. This results in a slight swelling of the bark, and when the birds reopen the old wounds year after year, as they habitually do, succeeding wood layers make excess growth and in time shelflike girdles develop. On trees having thin, flexible, rapidly growing bark, the swollen girdles are smoothly covered and rounded (fig. 5; Pl. IV, fig. 3), but on trees having thick, brittle, or stiff bark, the bark breaks and a gaping furrow is formed at the summit of the swelling (Pl. VII, figs. 2 and 3; Pl. VIII, fig. 1; Pl. IX, fig. 2; Pl. X, fig. 1). Some trees are remarkably deformed by such protruding girdles (fig. 5.)

Buds are apt to start from the edges of holes drilled by sapsuckers and form twigs or small branches. Such shoots have been noted on honey locusts and sycamores, and in some trees, such as willows and elms, which are prone to produce adventitious buds, they arise from sapsucker injuries in such numbers as to materially disfigure the trees.

The bark may be otherwise disfigured, as by exudations of gum or by pitch streams, or sapsucker injury may be followed by fungus attack, as in certain pines. Spores of *Peridermium cerebrum* sometimes reach the wood through sapsucker punctures and cause knotty gall-like outgrowths which greatly disfigure the trees.

The wood also is often distorted and discolored in such a way as to destroy its commercial value. This phase of damage by sapsuckers is exceedingly important and will be made the subject of a separate section of the bulletin.



FIG. 5.—Sapsucker work on honey locust (*Gleditsia triacanthos*). Protruding girdles. Specimen is 18 inches in diameter.

**EFFECTS OF SAPSUCKER WORK ON THE HEALTH OF TREES.**

Bendire says: "In certain localities, as where apple orchards are abundant, it [the yellow-bellied sapsucker] becomes a nuisance, and materially injures and eventually kills many such trees."<sup>1</sup> In the State of Washington whole orchards of young apple trees have been destroyed by sapsuckers, either by the western form of the yellow-bellied woodpecker or by the red-breasted sapsucker. The latter species injures other trees also, as related by Ellwood Cooper, of Santa Barbara, Cal. He says:

There were no trees killed outright at the time the sapsuckers were so bad, but many of them ceased to be useful as fruit bearers. Some apple trees died back at the top and did not thrive, so that I cut them down as useless, also a few English walnut trees. The orange trees had my special attention. I used the knife, cutting out the injured place, covered the wood with grafting wax, and had the bark heal over. The trees are living now and thriving. I have a few blue gums (*Eucalyptus globulus*) that show injury at this time. I consider the birds a pest. There were many other trees injured. I hired a boy to shoot the red-headed woodpeckers [i. e., the red-breasted sapsuckers] and intend to do so the coming spring. (Jan. 22 and Feb. 8, 1909.)

B. Horsford, of Springfield, Mass., writes as follows concerning the yellow-bellied sapsucker:

I have seen the white birch cut off, or rather broken off, 20 feet from the ground in more cases than I can number—all his work. I have seen the yellow birch destroyed in the same manner—branches of the tree cut off, shriveled branches struggling for life, but dying. I have seen a tree girdled with spots 20 feet from the ground, then again a few feet lower, then below that, repeating the process to the roots, leaving a dead and dry section above each belt. I have seen the white pine destroyed in the same way. . . . I have seen an elm tree 18 inches in diameter, whose trunk of 12 feet was spotted with "gimlet holes" . . . where for 10 summers past I have shot the pest and thereby saved the tree. . . . Where the bird breeds, whole orchards are severely injured, if not destroyed. . . . The leaves fade and the fruit withers on the stem or falls to the ground. Perhaps not half the apple trees attacked are killed outright, but the birch tree invariably dies.<sup>2</sup>

Even forest trees are not immune from injury by sapsuckers. Prof. W. W. Cooke, of the Biological Survey, states that near Lake Itasca, in northern Minnesota, where the birds breed, the yellow-bellied is the most common woodpecker. It does much mischief among forest trees, killing many great poplars by its girdles.

Mr. A. W. Butler says:

It knows when sugar making begins. . . . I have found their borings, from which sap was flowing, February 19, 1896. Through March and April they continue their work. . . . In fall when they come to us they resume their work of piercing the bark of maple, apple, and other trees. . . . I have found their fresh work on young apple trees, never before pierced, as late as November 19, 1895. Pine trees are also girdled, chiefly, however, through the winter, for among them the sapsucker spends his winter, and about lawns where pines and maples grow together they are most commonly found at that season. By spring they have removed most of the bark scales

<sup>1</sup> Bendire, C., *Life Histories of N. A. Birds*, II, 84-85, 1895.

<sup>2</sup> *Forest and Stream*, XX, 124, 1883.

from the pine, and it then appears quite clean. The resin flows from the wounds the bird has made and forms milky streaks and gummy excrescences later in the season, which look unsightly. . . . The pines are weakened, their tops girdled until they become bent and even blown off by the wind. Apple trees and choice maples are seriously damaged. . . . I have counted six of these birds at one time on a dozen sugar maples in front of one lot in my own town, and have seen the sap flow in a stream.<sup>1</sup>

Dr. P. R. Hoy gives evidence of damage by yellow-bellied sapsuckers. In 1865 he wrote as follows:

They . . . energetically attack the maple, mountain ash, pine, spruce, pear, apple, plum, cherry, peach, and silver poplar, . . . ironwood, wild cherry, and basswood. . . . It is during the autumnal visit that they do the greatest damage; for in spring, when the vital forces of vegetation are unusually active, the tree recovers more certainly from the wounds inflicted, while in the fall, vegetable life being less active, the septa between the punctures are more likely to dry, leaving the tree dead or crippled for life. The sapsuckers attack the most thrifty trees, but after they have suffered a siege from these sapsuckers, they are thrifty no more. If not killed, they are so stunted that they fall an easy prey to the bark lice, . . . for when an orchard tree is enfeebled from any cause, bark lice are sure to finish the work. . . . The damage done by these birds to orchards and ornamental grounds is considerable, second only to that of the bark louse. There is not a garden or orchard of any size in the vicinity of Racine [Wis.] that has not lost trees killed by the sapsucker.<sup>2</sup>

The instances above cited are sufficient to show that sapsuckers materially injure or even kill many trees of a wide variety of species. Subjoined are lists of the trees attacked by the three species of sapsuckers as complete as present information permits.

#### TREES ATTACKED BY THE YELLOW-BELLIED SAPSUCKER.

(*Sphyrapicus varius*.)

In these lists field notes on damage to certain trees are given, with locality and name of observer. The writer is responsible for citations with localities only (most of which are vouched for by specimens in the Biological Survey), for unsigned field notes, and for records of specimens in museums. The following abbreviations are used: A. A., Arnold Arboretum; A. M., American Museum of Natural History; F., Field Museum of Natural History; H., Hopkins collection. These symbols are accompanied by the numbers of the specimens in these wood collections. Notes from published sources are followed by the name of the author, and the bibliography following the lists supplies the complete references. The exception is a paper read by Dr. A. D. Hopkins before the Biological Society of Washington, which, although unpublished, is inserted in the bibliography. We are under the greatest obligations to Dr. Hopkins, who has furnished a vast amount of valuable data on sapsucker work. The scientific names of the trees agree in the main with those of Britton's *North American Trees*.<sup>3</sup>

<sup>1</sup> Indiana Dept. Geol., Annual Report 22 (for 1897). pp. 835-6, 1898.

<sup>2</sup> Trans. Ill. State Agr. Soc., V, 731-2, 1865.

<sup>3</sup> Britton, N. L., New York, 1908, pp. 894.

Names of families and the statistics as to the number of species in them are from the same book.

Included in this list are the names of many trees attacked by sapsuckers, but by which of the three species is not known. In view of the immense range of the yellow-bellied sapsucker, probably all these trees are at some time or other punctured by this species. Many of them are undoubtedly attacked by one of the other species, especially in the West by the red-breasted sapsucker.

The information concerning sapsucker attack on trees of various families is summarized for each family before presenting the evidence relating to the individual species. Following the family summaries are lists of all the species attacked, with detailed accounts of the species notably injured.

The yellow-bellied sapsucker, in addition to attacking trees, also works upon several vines. Sometimes a vine is riddled while the tree which supports it is untouched. The vines upon which punctures have been noted are:

DUTCHMAN'S PIPE (*Aristolochia macrophylla*).—West Virginia (F.), Abbeville, La.

POISON IVY (*Rhus toxicodendron*).—This vine is abundantly punctured by sapsuckers and sometimes partly or entirely killed, as at Longbridge, La.

RATTAN VINE (*Berchemia volubilis*).—Abbeville, La.

FROST GRAPE (*Vitis vulpina*).—Longbridge and Abbeville, La.

VIRGINIA CREEPER (*Psedera quinquefolia*).—Plummers Island, Md.

TRUMPET CREEPER (*Tecoma radicans*).—Cottonport and Abbeville, La.

These 6 species of vines belong to 5 families, 2 of which are not otherwise represented in the list.

#### THE MAIDENHAIR TREES (GINKGOACEÆ).

This family contains only a single species, a native of Japan, which is commonly cultivated for ornament in the United States. It is vigorously attacked by sapsuckers, but so far as known it is not materially defaced.

MAIDENHAIR TREE (*Ginkgo biloba*).—Along the central avenue of the Agricultural Department grounds in Washington are 76 trees of this species, of which 29, or 38 per cent, have been pecked by the yellow-bellied sapsucker. Some of the trees show numerous punctures, and in a few cases swollen girdles have resulted. One tree which divides into ten main trunks is closely punctured all over. The trees are disfigured, but as they are not especially prized for beauty of trunk, the blemishes are not serious.

## THE YEW FAMILY (TAXACEÆ).

Four arborescent species of this family occur in the United States, and three of them are known to be attacked by sapsuckers. These trees are little used for ornament, and as yet we have no evidence that sapsucker attacks have weakened or killed any of them.

## LIST OF TAXACEÆ ATTACKED.

FLORIDA YEW (*Taxus floridana*).—Bristol, Fla. (A. A. and A. M. 411).

STINKING CEDAR (*Tumion taxifolium*).—River Junction, Fla. (A. A. and A. M. 414.)

CALIFORNIA NUTMEG (*Tumion californicum*).—California (A. A. and A. M. 413).

## THE CONE-BEARING TREES (PINACEÆ).

This large and important family of trees includes many of the finest ornamental forms. Almost half of the total number of native species, as well as several introduced forms, are known to be attacked by sapsuckers. The following table shows the number of indigenous species in each genus of the family and the number subject to attack by sapsuckers. There is little doubt that all are punctured at times.

*Pinaceæ attacked by sapsuckers.*

Genus.	Number of native species.	Number of these attacked.	Introduced species attacked.
Pine ( <i>Pinus</i> ).....	36	16	2
Larch ( <i>Larix</i> ).....	3	0	1
Spruce ( <i>Picea</i> ).....	8	3	1
Hemlock ( <i>Tsuga</i> ).....	4	3	0
Fir ( <i>Pseudotsuga</i> ).....	2	1	0
Fir ( <i>Abies</i> ).....	10	5	0
Redwood ( <i>Sequoia</i> ).....	2	2	0
Bald cypress ( <i>Taxodium</i> ).....	2	1	0
Incense cedar ( <i>Heyderia</i> ).....	1	1	0
Arbor vitae ( <i>Thuja</i> ).....	2	1	0
Cypress ( <i>Cupressus</i> ).....	5	3	0
Cedar ( <i>Chamaecyparis</i> ).....	3	1	0
Juniper ( <i>Juniperus</i> ).....	12	5	0
	90	42	4

Several of the species attacked are known to have been seriously injured or killed, including 6 native and 2 introduced pines, 2 native and 1 introduced spruce, 2 native hemlocks, 2 firs, and 1 juniper.

For Butler's testimony concerning injuries to pines see pages 20–21. Steere makes a more serious charge, saying the bird "injures and oftentimes kills the pines, making so many holes that the trees bleed to death" (Annapolis, Md., Aug. 24, 1885).

Spruces, if not killed, are weakened and rendered unsightly. Wright says:

Here, in the garden, they attacked a large spruce one autumn, and the next spring the trunk was white with the sap that leaked from the hundreds of "taps," and the tree has never since recovered its vitality.

Among the coniferous trees so badly affected are the most beautiful and valuable ornamental species, defacement or destruction of which is a serious offense.

#### LIST OF PINACEÆ ATTACKED.

**WHITE PINE** (*Pinus strobus*).—The white pine is the most important tree of the eastern United States and is a valuable ornamental species. Hopkins states that young trees are injured or killed by sapsuckers; Horsford notes that he has "seen the white pine destroyed" by these birds; and Warren says: "In one garden [in Racine, Wis.] all the . . . white pine trees were entirely killed." Evidently this species suffers severely from sapsuckers, and, as it is so valuable, the loss is serious.

**LIMBER PINE** (*Pinus flexilis*).—Colorado (A. M. 499).

**WHITEBARK PINE** (*Pinus albicaulis*).—Washington (A. M. 498).

**ONE-LEAVED NUT PINE** (*Pinus monophylla*).—California (A. A. and A. M. 492).

**NUT PINE** (*Pinus edulis*).—Vermejo, N. Mex., May 6, 1903, (H.).

**CHIHUAHUA PINE** (*Pinus chihuahuana*).—Southern Arizona (A. M. 491).

**RED PINE** (*Pinus resinosa*).—This species is rather infrequently used for ornamental purposes and generally goes under the name Norway pine. Butler (1890) says: "Norway pines in my yard have been girdled until they became puny, sickly trees and were cut down, and one tree was so girdled about two-thirds of its height from the ground that it was broken off during a windstorm." A red pine in the grounds of the Smithsonian Institution at Washington bears considerable sapsucker work.

**BULL PINE** (*Pinus ponderosa mayriana*).—Santa Rita Mountains, Ariz. (A. M. 489).

**LODGEPOLE PINE** (*Pinus murrayana*).—Uintah Mountains, Medicine Bow Range, Wyo. and Utah (II. 6175b).

**LONG-LEAF PINE** (*Pinus palustris*).—At the Santee Club, South Carolina, fully 50 per cent of the long-leaf pines bear sapsucker work, some to a disfiguring degree, as protruding girdles have resulted. At Gainesville, Fla., sapsucker pecking is also plentiful on this species, but on St. Vincent Island, Fla., only a few trees are punctured. Hopkins notes that the sapsucker injures or kills young trees. (His specimens are from Baldwin, Fla.; Boardman, N. C.; and Buna, Tex.) Ernest Napier, of the Game Commission of New

Jersey, states that many young trees of this species in Lee County, Fla., have been killed by sapsuckers. The long-leaf pine is attacked throughout its range.

**PITCH PINE** (*Pinus rigida*).—Many trees of this species in the vicinity of Washington, D. C., show abundant evidence of sapsucker attack. A specimen from Delslow, W. Va. (H. 6653), is from a tree which was killed by yellow-bellied sapsuckers (Pl. V, fig. 6). The sapsucker pecks are in vertical rows and are so numerous and closely placed that nearly half the bark is removed. Pitch pines in Rockfish Valley, Va., also are attacked.

**POND PINE** (*Pinus serotina*).—Santee Club, South Carolina.

**SHORT-LEAF PINE** (*Pinus echinata*).—Hopkins states that young trees are injured or killed by sapsuckers. Specimens collected near Seven Locks, Montgomery County, Md., show that sapsucker injuries are sometimes followed by an attack of the fungus *Peridermium cerebrum*, causing large gall-like outgrowths which greatly disfigure the trees.

**SPRUCE PINE** (*Pinus glabra*).—Santee River, S. C. (A. M. 472):

**SCRUB PINE** (*Pinus virginiana*).—The statement regarding fungus attack in *echinata* applies also to this species, which we know to be punctured by sapsuckers at Morgantown, W. Va. (H.), and in the vicinity of the District of Columbia. A dead tree on Plummers Island, Md., showed a band 8 to 10 inches wide of closely set punctures, and in other parts of the tree vertical strips of the bark had been removed. Death may well have been due to the sapsucker injuries.

**TABLE-MOUNTAIN PINE** (*Pinus pungens*).—Fairfax County, Va.

**AUSTRIAN PINE** (*Pinus laricio austriaca*).—This species is widely used for ornamental planting in the United States. It is often disfigured or even killed by the yellow-bellied sapsucker. Widmann (see Bendire) says it is the bird's "favorite tree among our ornamental evergreens. . . . The exudations of resin, the secondary result of the sapsucker's labors, mar the appearance of the trees by running down their sides or hardening into unsightly lumps." Clifford states that the sapsuckers "do great damage to the . . . Austrian pines, sometimes girdling them so as to kill them," and Purdy notes that this species is one of the sapsucker's preferred food trees. An Austrian pine in the Department of Agriculture grounds bears considerable sapsucker work. Some of the pits are exceptionally large, and many are arranged in vertical rows. Dr. A. K. Fisher says that one of 7 or 8 Austrian pines at his old home in Ossining, N. Y., was favored by sapsuckers and worked upon extensively every fall.

**SCOTCH PINE** (*Pinus sylvestris*).—This tree is occasionally planted for ornament and suffers from sapsuckers almost as severely as the Austrian pine. Widmann (see Bendire) says the Scotch pine is the

bird's second choice among our ornamental evergreens. The trunks and larger limbs . . . look very badly at times." Purdy notes that the Scotch pine is a favorite with the sapsuckers, and Clifford states that the birds sometimes kill it.

EUROPEAN LARCH (*Larix decidua*).—Massachusetts, Kennard.

NORWAY SPRUCE (*Picea excelsa*).—This tree is extensively planted for ornamental purposes. According to Elliott, the sapsucker "in its fondness for cambium often removes considerable fresh bark. I have seen several fine Norway spruces ruined in this way."

RED SPRUCE (*Picea rubens*).—Randolph County, W. Va. (F. 74878); Davis, W. Va. (H. 6626b).

ENGELMANN SPRUCE (*Picea engelmanni*).—Sandpoint, Idaho (H. 195a).

WEeping SPRUCE (*Picea breweriana*).—Northern California (A. M. 457).

TIDELAND SPRUCE (*Picea sitchensis*).—Push, Oreg. (H. 121a).

EASTERN HEMLOCK (*Tsuga canadensis*).—This graceful and stately tree, a gem among ornamental conifers, is not spared by sapsuckers. Allen says: "In Vermont where I have observed *S. varius* [the yellow-bellied sapsucker] in abundance, no trees were so extensively perforated as the hemlock." Bendire says the sapsucker "is partial to the . . . hemlock;" and Hopkins notes that the bird injures or kills young trees. (Specimens from Allegheny Mountains, W. Va.)

SOUTHERN HEMLOCK (*Tsuga caroliniana*).—South Carolina (A. M. 454); Habersham County, Ga., December 18, 1909 (F.).

WESTERN HEMLOCK (*Tsuga heterophylla*).—Detroit, Oreg., June 2, 1899 (H.); Hoquiam, Wash. (H. 2167a) (see Pl. VIII, fig. 3).

DOUGLAS FIR (*Pseudotsuga mucronata*).—St. Helena, Oreg. (H. 116a).

WHITE FIR (*Abies concolor*).—Oregon (A. M. 444); San Bernardino Mountains, Cal. Grinnell.

WHITE FIR (*Abies grandis*).—Oregon (A. M. 446); McCloud, Cal. (H. 21).

WHITE FIR (*Abies amabilis*).—Oregon (A. M. 447).

RED FIR (*Abies magnifica*).—California (A. M. 441).

RED FIR (*Abies nobilis*).—Oregon (A. M. 442).

BIG TREE (*Sequoia washingtoniana*).—Near Grant National Park, Cal. (A. A. and A. M., 438).

REDWOOD (*Sequoia sempervirens*).—Eureka, Cal. (H.).

BALD CYPRESS (*Taxodium distichum*).—Boardman, N. C., March 25 and April 3, 1904 (H.); Cottonport, La., Longbridge, La.

INCENSE CEDAR (*Heyderia decurrens*).—Oregon (H.).

CANOE CEDAR (*Thuja plicata*).—Washington, May 3, 1899 (H.).

MONTEREY CYPRESS (*Cupressus macrocarpa*).—Monterey, Cal. (A. M. 432).

GOWEN CYPRESS (*Cupressus goveniana*).—California (A. M., 430).

MACNAB CYPRESS (*Cupressus macnabiana*).—Lake County, Cal. (A. M. 429).

WHITE CEDAR (*Chamæcyparis thyoides*).—Dismal Swamp, Va. November 21, 1901 (H.); Atsion, N. J. (A. M. 428).

DESERT JUNIPER (*Juniperus utahensis*).—Utah (A. A. and A. M. 422).

WESTERN JUNIPER (*Juniperus occidentalis*).—California (A. M. 420).

ROCK CEDAR (*Juniperus mexicana*).—Austin, Tex. (A. M. 418.)

NORTHERN RED CEDAR (*Juniperus virginiana*).—This species is commonly attacked by sapsuckers. Mr. J. M. Thompson states that it is one of the bird's principal food trees, and Mr. F. K. Steere says it is often badly hurt by the sapsucker (letter from Annapolis, Md., Aug. 24, 1885). Of 40 red cedar trees on a part of Plummers Island, Md., 19 are covered with closely set sapsucker punctures. Specimens from Florida (A. M. 417); Kanawha Station, W. Va. September 28, 1903 (H.); and Illinois (F. 26487) show abundant sapsucker work.

SOUTHERN RED CEDAR (*Juniperus barbadensis*).—Jacksonville, Fla. (A. M. 416).

#### THE POPLARS AND WILLOWS (SALICACEÆ).

There are 15 native species of poplar in the United States, 8 of which, besides 1 introduced tree, are known to be attacked by sapsuckers. The only instance of serious injury to poplars that has come to notice was communicated verbally by Prof. Cooke of the Biological Survey. He states that in northern Minnesota, where the yellow-bellied sapsucker is common in summer, it kills many large poplar trees in the forests.

Willows are often seriously injured. Hopkins says the sapsucker injures or kills young trees, and specimens of small willows (Pl. V, fig. 5) collected by him in the Black Hills, S. Dak., September 3, 1901, show almost complete barking. Grinnell reports that sapsuckers kill many white willows (*Salix lasiolepis*). Fifteen of the 26 native arborescent willows are known to be attacked.

The injury to willows and poplars by sapsuckers is unfortunate, since these trees are valuable for shade, for ornament, and for protecting the banks of water courses.

#### LIST OF SALICACEÆ ATTACKED.

SILVER POPLAR (*Populus alba*).—Washington, D. C., April 26, 1903 (H.); Albany, N. Y., Hough; Racine, Wis., Hoy, 1865.

SWAMP POPLAR (*Populus heterophylla*).—Louisiana or Alabama (A. A. and A. M. 378).

BLACK COTTONWOOD (*Populus trichocarpa*).—Seattle, Wash. (A. A. and A. M. 373).

BALM OF GILEAD (*Populus candicans*).—New Hampshire (A. A. and A. M. 377).

COTTONWOOD (*Populus acuminata*).—Nebraska (A. M. 374).

TACMAHAC (*Populus balsamifera*).—Essex County, N. Y. (A. A. and A. M. 376); Lewis County, N. Y. (Hough).

CAROLINA POPLAR (*Populus deltoides*).—Texas (A. M. 372); Venice, La.

ASPEN (*Populus grandidentata*).—Rawdon, Nova Scotia (A. M. 379).

ASPEN (*Populus tremuloides*).—Mackenzie Valley, Canada (E. A. Preble).

BLACK WILLOW (*Salix nigra*).—Belle Isle, La.

WARD WILLOW (*Salix longipes*).—St. Louis, Mo. (A. A. and A. M. 368).

CALIFORNIA BLACK WILLOW (*Salix lævigata*).—California (A. A. and A. M. 366).

WILLOW (*Salix toumeyii*).—Santa Catalina Mountains, Ariz. (A. A. and A. M. 365).

PEACH-LEAVED WILLOW (*Salix amygdaloides*).—New Mexico (A. A. and A. M. 367).

WESTERN BLACK WILLOW (*Salix lasiandra*).—California (A. A. and A. M. 362 and A. M. 364).

SANDBAR WILLOW (*Salix interior*).—New Orleans, La. (A. M. 360).

SILVER-LEAVED WILLOW (*Salix sessilifolia*).—California (A. A. and A. M. 359).

WILLOW (*Salix missouriensis*).—Furness, Nebr. (A. M. 356).

WHITE WILLOW (*Salix lasiolepis*).—California (A. A. and A. M. 357). According to Britton, the name *Salix bigelovii* is a synonym of *S. lasiolepis*. Hence the following note is incorporated here (see Pl. VI):

Near Bluff Lake [Cal.] a species of willow (*Salix bigelovii*) grows in good-sized clumps . . . and these willows seem to offer special attraction to the sapsuckers. But curiously enough the attentions of the birds are confined to a single clump in a locality. . . . The incisions in the bark were generally rectangular, the long axis horizontal, and in vertical rows. These up-and-down rows of incisions often ran together, making vertical grooves, and sometimes also the rows were so close together as to obliterate the interval, so that the bark was completely gone over a considerable space. The trunk above this zone of attack was always partly or entirely dead. . . . This single willow clump . . . was rendered conspicuous by all its upper branches and stalks, above 2 to 4 feet from the ground, being dead, with the bark weathered off and the stems left bare and shining. (Grinnell, 1908.)

WILLOW (*Salix hookeriana*).—Oregon (A. A. and A. M. 353).

YEW-LEAVED WILLOW (*Salix taxifolia*).—Swisshelm Mountains, Ariz. (A. A. and A. M. 358 and A. M. 361).

SATIN WILLOW (*Salix sitchensis*).—California (A. A. and A. M. 352).



WORK OF SAPSUCKER ON WILLOW.

[Sierra sapsucker (*Sphyrapicus v. daggetti*) at Bluff Lake, California, September 3, 1905.  
By J. Grinnell.]



GLAUCOUS WILLOW (*Salix discolor*).—Vermont (A. A. and A. M. 355).

WILLOW (*Salix scouleriana*).—Oregon (A. A. and A. M. 354).

#### THE BAYBERRIES (MYRICACEÆ).

There are four arborescent species<sup>1</sup> of this family in the United States, of which three are known to be attacked by sapsuckers, one at least being sometimes in part or entirely killed. However, these small trees have slight economic value and are little used for ornamental planting.

#### LIST OF MYRICACEÆ ATTACKED.

BAYBERRY (*Myrica carolinensis*).—Church Island, N. C.

WAX MYRTLE (*Myrica cerifera*).—Florida (A. M. 384); Santee Club, South Carolina.

CALIFORNIA BAYBERRY (*Myrica californica*).—California (A. M. 382).

#### THE WALNUTS AND HICKORIES (JUGLANDACEÆ).

Sapsuckers are known to attack 3 of the 5 native species of walnut besides 1 introduced species, and 11 of the 14 native hickories. Throughout their range hickory trees usually are severely attacked by sapsuckers. We know of but one hickory being killed, but they are often disfigured by swollen girdles. Sapsuckers cause much staining and distortion in the wood of hickories.

#### LIST OF JUGLANDACEÆ ATTACKED.

BUTTERNUT (*Juglans cinerea*).—Fairfax County, Va.

BLACK WALNUT (*Juglans nigra*).—Allenton, Mo. (A. M. 399); Indianapolis, Ind. (H. 24236); Rockfish Valley, Va.; Beltsville, Md.

TEXAN WALNUT (*Juglans rupestris*).—Arizona (A. A. and A. M. 398).

ENGLISH WALNUT (*Juglans regia*).—A tree on the grounds of the Department of Agriculture in Washington bears profuse evidence of sapsucker work. One limb has been killed on one side.

NUTMEG HICKORY (*Hicoria myristicæformis*).—Oakley, S. C. (A. M. 392).

PECAN (*Hicoria pecan*).—Butler County, Mo. (F. 72458); Illinois (F. 26454); Allenton, Mo. (A. A. and A. M. 395); Pantherburn, Miss.; Department of Agriculture grounds, District of Columbia.

TEXAN PECAN (*Hicoria texana*).—Columbia, Tex. (A. A. 394).

<sup>1</sup> Only 3 arborescent species are mentioned in Britton's North American Trees, but *Myrica carolinensis* Miller (= *Myrica cerifera intermedia* Chapman, fide Sudworth) is typically tree-like on the shores of Currituck Sound, N. C.

**BITTER PECAN** (*Hicoria aquatica*).—Southern Arkansas (A. A. and A. M. 391); Cottonport and Longbridge, La.

**BITTER NUT** (*Hicoria cordiformis*).—West Virginia (F. 73488); Allenton, Mo. (A. A. and A. M. 393); Seven Locks, Montgomery County, Md.; Department of Agriculture grounds, District of Columbia.

**MOCKER NUT** (*Hicoria alba*).—This species is very commonly attacked by sapsuckers. A tree in Fairfax County, Va., examined March 21, 1909, bore many protruding girdles (Pl. X, fig. 1) where the birds had pecked in the same place year after year, besides a great deal of less conspicuous work. Plate IX, figure 2, shows similar girdles on another tree which is fully 2 feet in diameter. At the date specified there were many fresh drills in the girdles and elsewhere, and sap was flowing freely. Evidently growth is vigorous in this species, as a plug of wood grows out through almost every hole in the bark. About all the sapsucker has to do when he visits the tree the next year is to knock out the plugs. However, he usually punctures a layer or two of sapwood to insure a good flow of sap. A dead tree of this species near the same locality was evidently killed by sapsuckers. It bore more than a hundred nearly or entirely complete girdles of holes, besides numerous less perfect ones. In fact it was riddled from bottom to top. (Pl. IX, fig. 3.) From an examination of sections of this tree it was learned that all this work has been done in five years or less. Much of it never healed. The mocker nut is severely attacked in the vicinity of Cloverdale, Ind. (letter from J. B. Burris; Dec. 9, 1901), and to some extent also in Illinois (F. 26457).

**BIG SHELLBARK** (*Hicoria laciniosa*).—Morgantown, W. Va. (H.); Illinois (F. 26458); Department of Agriculture grounds, District of Columbia.

**SHELLBARK** (*Hicoria ovata*).—Widmann (see Bendire) notes that this species is "occasionally punctured." A specimen from Butler County, Mo., shows many pecks (F. 72449), and a tree in the Agriculture Department grounds at Washington has on the limbs many sapsucker girdles, which cause the bark to split and peel off more than it naturally would.

**SOUTHERN SHELLBARK** (*Hicoria carolinæ-septentrionalis*).—Rome, Ga. (A. M.).

**PIGNUT** (*Hicoria glabra*).—Weed and Dearborn state that sapsuckers "puncture the pignut hickory," and C. G. Bates says:

Bird pecks are common almost everywhere that hickories are found, but perhaps nowhere is the damage so serious as on the southerly slopes of the Cumberland Mountains of Tennessee, where the hickory, mostly pignut, occurs in rather open stands with chestnut oak, which is also frequently attacked by the sapsucker. (Dec. 15, 1908.)

Specimens from Butler County, Mo. (F. 72438), and Abbeville, La., show profuse sapsucker work, including large swollen girdles. A tree only an inch in diameter, on Plimmers Island, Md., had been attacked by sapsuckers.

WOOLLY PIGNUT (*Hicoria villosa*).—Huntsville, Ala. (A. A. and A. M. 385).

#### THE HORNBEAMS, BIRCHES, AND ALDERS (BETULACEÆ).

Ten of the 26 native arborescent species of this family, besides 1 introduced tree, are known to be attacked by sapsuckers. They are tabulated by genera below:

Genus.	Number of native species.	Native species attacked.	Introduced species attacked.
Hornbeams ( <i>Carpinus</i> ).....	1	1	1
Hop hornbeams ( <i>Ostrya</i> ).....	2	2	0
Hazelnuts ( <i>Corylus</i> ).....	1	0	0
Birches ( <i>Betula</i> ).....	14	5	0
Alders ( <i>Alnus</i> ).....	8	2	0
	26	10	1

Two of the hornbeams and two hop hornbeams are much disfigured by sapsuckers, and at least two species of birches are frequently killed. Trees like the hornbeams with smooth close bark, and birches, which are prized for the beauty of their silvery white trunks, lose much of their ornamental value when disfigured by abundant sapsucker puncturing. Birches in particular are among the most valuable ornamental trees, and the fact that they are often killed by sapsuckers weighs heavily against the birds.

#### LIST OF BETULACEÆ ATTACKED.

HORNBEAM (*Carpinus caroliniana*).—This tree when attacked is generally severely blemished (fig. 6). One in the Agricultural Department grounds is disfigured by a great many girdles, some of which are considerably swollen. In the vicinity of Gainesville, Fla., hornbeams are plentifully punctured, and at Abbeville, La., most of the hornbeams in the woods bore abundant sapsucker work. Specimens examined from Illinois (F. 26482), Morgantown, W. Va. (H.), and southern Arkansas (A. A. 351) are profusely punctured.

EUROPEAN HORNBEAM (*Carpinus betula*).—Department of Agriculture grounds, District of Columbia.

HOP HORNBEAM (*Ostrya virginiana*).—Morgantown, W. Va. (H.); Massachusetts (A. A. and A. M. 350).

HOP HORNBEAM (*Ostrya knowltoni*).—Talfrey, Ariz. (A. A. and A. M. 349).

**GRAY BIRCH** (*Betula populifolia*).—Department of Agriculture grounds, District of Columbia.

**WHITE or CANOE BIRCH** (*Betula alba*).—This tree is frequently and seriously injured by sapsuckers (Pl. V, fig. 2). Weed and Dearborn say that "hundreds of punctures" are "made in white birches" and Hopkins notes that the sapsucker injures or kills young trees. Bolles, in writing of a sapsucker "orchard," states that "The tree in use last year was nearly dead. Two neighboring birches showing scars of earlier years were quite dead. . . . Orchard No. 4 . . . consisted of a large number of dead and a few living trees. . . . The part of the orchard in use was a birch, from whose roots rose 4 major trunks quickly subdividing into 15 minor stems each rising

ing to a height of over 30 feet. All of the 15 trunks were dead or dying. Only 7 of them bore leaves." "Hermit," speaking of a sapsucker "orchard," says: "The . . . canoe birches were dead or dying. Many . . . had been broken off by the wind just below the belt of punctures." Horsford says: "I have seen the white birch cut off, or rather broken off, 20 feet from the ground, in more cases than I can number, all his work. . . . The birch tree invariably dies." And Garfield notes that "This



FIG. 6.—Sapsucker work on hornbeam (*Carpinus caroliniana*).

bird invariably attacks what appears to be perfectly sound and healthy bark. Great injury is inflicted by these attacks. . . . The white birch is frequently killed." George H. Selover writes that sapsuckers have often killed silver birches at Lake City, Minn. (letter, 1885). The tree is attacked in Maine also (H.).

**WHITE BIRCH** (*Betula pendula*).—Department of Agriculture grounds, District of Columbia.

**CHERRY BIRCH** (*Betula lenta*).—West Virginia (H.).

**YELLOW BIRCH** (*Betula lutea*).—The sapsucker "is partial to the . . . yellow birch" (Bendire), and it "injures or kills young trees" (Hopkins). William Brewster says that the yellow birch is very

commonly attacked in western Maine, and Horsford states: "I have seen the yellow birch destroyed . . . branches of the tree cut off, shriveled branches struggling for life, but dying."

**ALDER** (*Alnus incana*).—A. A. 340; western Maine, William Brewster.

**WHITE ALDER** (*Alnus rhombifolia*).—San Bernardino Mountains, Cal., Grinnell.

#### THE BEECHES, CHESTNUTS, AND OAKS (FAGACEÆ).

Thirty-four of the 68 native arborescent species of this important family of trees and 2 introduced forms are known to be attacked by sapsuckers. Usually the injury does not seem to affect the vigor of oaks, and we know of few instances of the external appearance of the trees being altered for the worse. A sample of a dying live oak, sent to the Bureau of Entomology from Glen Rose, Tex., shows no injury except by sapsuckers, and Bolles implies that red oaks are sometimes killed. On the whole, the evidence at hand, while showing that a large number of species of this family are attacked by sapsuckers, does not indicate serious injury to their appearance or health.

#### LIST OF FAGACEÆ ATTACKED.

**BEECH** (*Fagus grandifolia*).—Morgantown, W. Va. (H.); Rawdon, Nova Scotia (A. A. and A. M. 334); Massachusetts, Weed and Dearborn.

**CHINQUAPIN** (*Castanea pumila*).—Southern Arkansas (A. A. and A. M. 332).

**CHESTNUT** (*Castanea dentata*).—Pickens, W. Va. (II. 6687a); Townsend Center, Mass. (A. M. 333); Montgomery County, Md.; Afton and Rockfish Valley, Va.

**TANBARK OAK** (*Pasania densiflora*).—Hopkins.

**RED OAK** (*Quercus rubra*).—Bendire remarks that sapsuckers are "partial to the . . . red oak," and Bolles says it is "drilled for successive years," adding that "the forest trees attacked by them generally die." Five red oaks in the Department of Agriculture grounds show sparing sapsucker work; many trees about Afton, Va., are attacked, and a specimen from Allenton, Mo., shows that the tree is visited there also (A. M. 329).

**PIN OAK** (*Quercus palustris*).—Every tree of this species over a considerable area in the vicinity of Dead Run Swamp, Fairfax County, Va., bears profuse marks of sapsucker attack.

**TURKEY OAK** (*Quercus catesbæi*).—Florida (A. M. 322).

**BLACK OAK** (*Quercus velutina*).—Abbeville, La.

**TEXAS OAK** (*Quercus texana*).—Abbeville, La.

SCARLET OAK (*Quercus coccinea*).—Department of Agriculture grounds, District of Columbia.

SPANISH OAK (*Quercus triloba*).—Florida (A. M. 321).

SWAMP SPANISH OAK (*Quercus pagodaefolia*).—Abbeville, La.

WATER OAK (*Quercus nigra*).—Illinois (F. 26474); Santee Club, South Carolina.

WILLOW OAK (*Quercus phellos*).—Missouri (A. M. 317); Department of Agriculture grounds, District of Columbia.

LAUREL OAK (*Quercus laurifolia*).—Abbeville, La.

SHINGLE OAK (*Quercus imbricaria*).—Missouri (A. M. 313); Department of Agriculture grounds, District of Columbia.

WHITE-LEAF OAK (*Quercus hypoleuca*).—Southern Arizona (A. M. 308).

CALIFORNIA LIVE OAK (*Quercus agrifolia*).—Newhall, Cal. (A. M. 312).

WHITE LIVE OAK (*Quercus chrysolepis*).—California (A. A. and A. M. 306).

LIVE OAK (*Quercus virginiana*).—Fully 90 per cent of the live oaks at the Santee Club, South Carolina, are abundantly pecked, some having protruding girdles. At Gainesville, Fla., a large proportion of the live oaks are punctured, generally profusely, while on St. Vincent Island, Fla., though many trees are pecked, the work is usually scanty. A specimen from Glen Rose, Tex. (presented by Dr. Hopkins, October 4, 1909), is rather closely punctured.

NET-LEAF OAK (*Quercus reticulata*).—Southern Arizona (A. A. and A. M. 285).

TEXAN WHITE OAK (*Quercus breviloba*).—Austin, Tex. (A. A. and A. M. 292).

SHIN OAK (*Quercus undulata*).—Arizona (A. M. 291).

TOUMEY OAK (*Quercus toumeyii*).—Mule Mountains, Ariz. (A. M. 286).

CHAPMAN OAK (*Quercus chapmani*).—Apalachicola, Fla. (A. A. and A. M. 299).

CHESTNUT OAK (*Quercus prinus*).—A sapling near the Seven Locks, Montgomery County, Md., shows considerable sapsucker work, which deforms its trunk. In the Cumberland Mountains of Tennessee this species is frequently attacked (C. G. Bates, Dec. 15, 1908), and a specimen in the Field Museum (No. 72968) shows that it is worked on vigorously in West Virginia.

COW OAK (*Quercus michauxii*).—Many trees of this species are abundantly punctured, frequently with unusually large holes (made necessary by the thickness of the bark) in the vicinity of Longbridge, Cottonport, and Abbeville, La.

SWAMP WHITE OAK (*Quercus bicolor*).—Missouri (A. A. 296); Department of Agriculture grounds, District of Columbia.

**OVERCUP OAK** (*Quercus lyrata*).—Southern Arkansas (A. M. 297); Illinois (F. 26519); Butler County, Mo. (F. 72988); Department of Agriculture grounds, District of Columbia.

**CALIFORNIA WHITE OAK** (*Quercus lobata*).—California (A. M. 303).

**WESTERN WHITE OAK** (*Quercus garryana*).—Grant Pass, Oreg., April 25, 1899 (H.); California (A. M. 302).

**COLORADO WHITE OAK** (*Quercus leptophylla*).—Colorado (A. A. and A. M. 301).

**POST OAK** (*Quercus stellata*).—Missouri (A. M. 300); Santee Club, South Carolina; Longbridge, La.

**WHITE OAK** (*Quercus alba*).—White oaks show more evidence of sapsucker attack than any other species of the genus in the vicinity of Washington. In some localities large numbers of the trees are closely punctured and girdled. Sapsucker work is very common on this species about Afton, Va., and the tree is attacked also in West Virginia (H.) and near Winston-Salem, N. C.

**ENGLISH OAK** (*Quercus robur*).—Specimens of the horticultural variety of this species known as *Quercus sessiliflora cochleata*, the subspecies *pedunculata*, and its cultivated form *incisa*, five trees in all, on the grounds of the Department of Agriculture, bear rather abundant puncturing.

**EUROPEAN OAK** (*Quercus conferta* and var. *pannonica*).—Department of Agriculture grounds, District of Columbia.

#### THE ELMS AND HACKBERRIES (ULMACEÆ).

This family comprises 17 native trees belonging to 4 genera. Eight of the native species and 2 introduced forms are known to be attacked by sapsuckers. Disfiguring swollen girdles have been noted on 2 species of elm and 1 of hackberry, and 1 of the elms is said to be reduced in vigor by excessive pecking.

Genus.	Number of native species.	Native species attacked.	Introduced species attacked.
Elm ( <i>Ulmus</i> ).....	6	5	2
Water elm ( <i>Planera</i> ).....	1	1	0
Hackberry ( <i>Celtis</i> ).....	9	2	0
<i>Trema</i> .....	1	0	0
	17	8	2

#### LIST OF ULMACEÆ ATTACKED.

**CEDAR ELM** (*Ulmus crassifolia*).—Matteson, Miss. (F.).

**ROCK ELM** (*Ulmus thomasi*).—Lansing, Mich. (A. M. 280).

**WINGED ELM** (*Ulmus alata*).—Aiken, S. C. (A. M. 281).

**WHITE ELM** (*Ulmus americana*).—Bendire remarks that the sapsucker "is partial to the . . . elm;" and Horsford says: "I have

seen an elm tree 18 inches in diameter whose trunk of 12 feet was spotted with 'gimlet holes' in the bark nearly 1 inch thick, and where for 10 summers past I have shot the pests and thereby saved the tree." A white elm in the Smithsonian grounds is much disfigured by sapsucker girdles and one near Scotts Run, Fairfax County, Va., bears more conspicuous work of the same character, some of the girdles being 3 feet long and gaping as much as 3 inches (Pl. VII, fig. 2). Specimens examined show that the tree is attacked in West Virginia (H.), Illinois, and in Butler County, Mo. (F. 26445 and 73249, respectively).

**SLIPPERY ELM** (*Ulmus fulva*).—Specimens examined show that this species is attacked by sapsuckers in Missouri (A. M. 278) and West Virginia (H.). Sapsucker work was noted on slippery elms near Abbeville, La., and trees seen near Longbridge, La., were covered with rows of punctures, some of which had swollen into projecting girdles.

**ENGLISH ELM** (*Ulmus campestris*) AND **SCOTCH ELM** (*Ulmus montana*).—In the Agricultural Department grounds are 31 elms, 9 of which are marked by sapsuckers. Some are profusely punctured and both of the European species, as well as the American elm, are attacked.

**WATER ELM** (*Planera aquatica*).—Arkansas (A. A. and A. M. 275).

**HACKBERRY** (*Celtis occidentalis*).—Iron County, Mo. (F. 72268); Allenton, Mo. (A. M. 273).

**HACKBERRY** (*Celtis mississippiensis*).—Sapsucker pecking is very abundant on trees of this species in the vicinity of Cottonport and Longbridge, La. A peculiar effect of sapsucker work on this tree is that rings of bark are often formed about the punctures. They may be half an inch in height, and as they are round and open, a cluster of them on the gray bark forms a model in miniature of a colony of cliff swallows' nests.

#### THE FOUR O'CLOCK FAMILY (NYCTAGINACEÆ).

The single arborescent species in our flora is attacked by sapsuckers.

**BLOLLY** (*Torrubia longifolia*).—Florida Keys (A. M. 264).

#### THE MAGNOLIAS AND TULIP TREES (MAGNOLIACEÆ).

Six of the 8 native magnolias, 3 introduced species, and the single native species of tulip trees are distinct favorites of the birds. Of 22 magnolias on the Department of Agriculture grounds half have been pecked. The resulting girdles in the smooth, ashy gray bark of some of the species are unsightly, and one of the trees, a bull bay, is much roughened and distorted. The tulip tree is attacked throughout its



**WORK OF SAPSUCKER ON WHITE ELM.**

[1, Near view of bark showing closeness of punctures. 2, View of trunk showing swollen girdles (second one above limbs is about 3 feet long). 3, Near view of part of this girdle.]



range, but we know of no case where this species has been killed by sapsuckers. One of the magnolias, however, seems to be more seriously affected.

LIST OF MAGNOLIACEÆ ATTACKED.

**CUCUMBER TREE** (*Magnolia acuminata*).—Trees of this species in the grounds of the Department of Agriculture are plentifully punctured by sapsuckers, but the work is inconspicuous in their rough bark. All cucumber trees observed in the upper part of Rockfish Valley, Va., bore sapsucker work, one having several large swollen partial girdles. The species is attacked in West Virginia also (H.).

**MOUNTAIN CUCUMBER TREE** (*Magnolia cordata*).—Department of Agriculture grounds, District of Columbia.

**BULL BAY** (*Magnolia grandiflora*).—Many of the trees bordering a long avenue at the Santee Club, South Carolina, bear sapsucker work. Trees in the vicinity of Longbridge, La., are abundantly punctured, and two specimens in the grounds of the Department of Agriculture at Washington have been attacked, one so vigorously that it is disfigured by numerous girdles. L. L. Wright, of Talladega, Ala., sent in a specimen of sapsucker work from a tree of this species which, he writes, is dying from the effects of whatever it is that is "honey-combing" the bark. From about 2 feet above the ground to the top of the tree it has been girdled at intervals of 15 to 24 inches, the holes varying from contact with each other to three-fourths of an inch apart. At about 8 feet above the ground a double girdle of holes has been made about an inch apart, and so deep as to remove the entire inner bark except for about 6 inches out of a circumference of nearly 3 feet. (March 18, 1911.)

**SWEET BAY** (*Magnolia virginiana*).—Department of Agriculture grounds, District of Columbia; Church Island, N. C.

**UMBRELLA TREE** (*Magnolia tripetala*).—Illinois (F. 26401).

**LARGE-LEAVED UMBRELLA TREE** (*Magnolia macrophylla*).—Department of Agriculture grounds, District of Columbia.

**EAST ASIAN MAGNOLIA** (*Magnolia yulan*).—Department of Agriculture grounds, District of Columbia.

**EAST ASIAN MAGNOLIA** (*Magnolia obovata*).—Department of Agriculture grounds, District of Columbia.

**EAST ASIAN MAGNOLIA** (*Magnolia hypoleuca*).—Department of Agriculture grounds, District of Columbia.

**TULIP TREE** (*Liriodendron tulipifera*).—This species is a distinct favorite with sapsuckers. Everywhere about Washington are trees bearing abundant sapsucker work. The same is true in the vicinity of Winston-Salem, N. C., and the tree is vigorously attacked in the Rockfish Valley, Va., in West Virginia (Delslow, H. 6687; Pickens, H. 6487a), and in Illinois (F. 26403).

## THE PAWPAWS AND POND APPLES (ANONACEÆ).

Two genera, each represented by one arborescent species, occur in the United States. One of these species, the pawpaw, is attacked by sapsuckers, but, so far as known, not seriously injured.

PAWPAW (*Asimina triloba*).—Arkansas (A. M. 255); Illinois (F. 26404); Fairfax County, Va.

## THE BAYS AND LAURELS (LAURACEÆ).

The following tabulation shows the arborescent members of this family in the United States and the number of species attacked by sapsuckers:

Genus.	Number of native species.	Native species attacked.	Introduced species attacked.
Red bays ( <i>Persea</i> ).....	3	2	0
Lancewood ( <i>Ocotea</i> ).....	1	0	0
Sassafras ( <i>Sassafras</i> ).....	1	1	0
Laurel ( <i>Umbellularia</i> ).....	1	1	0
Camphor ( <i>Cinnamomum</i> ).....	0	0	1
Spice bush ( <i>Benzoin</i> ) <sup>1</sup> .....	1	0	0
	7	4	1

<sup>1</sup> Not usually classed as arborescent, but according to Dr. A. K. Fisher it becomes a tree in Fairfax County, Va.

Sassafras and camphor trees are known to be killed by the birds and all of the other species attacked are badly disfigured. These trees are used for ornament, and sapsucker injury to them counts against the bird.

## LIST OF LAURACEÆ ATTACKED.

RED BAY (*Persea borbonia*).—Apparently all trees of this species in the vicinity of the Santee Club, South Carolina, are attacked by sapsuckers. Most of them are profusely punctured, and the exterior of one tree was much disfigured by numerous rings of pecks which had become swollen and produced gaping, knotty girdles. At Gainesville, Fla., a large proportion of the red bays bore abundant sapsucker work.

SWAMP RED BAY (*Persea pubescens*).—Trees of this species also were vigorously attacked near the Santee Club, South Carolina.

SASSAFRAS (*Sassafras variifolium*).—The sapsucker injures or kills young trees (Hopkins). (Specimen from Monongalia County, W. Va., Mar. 17, 1894. Pl. XI, fig. 4.)

CALIFORNIA LAUREL (*Umbellularia californica*).—A specimen from California shows evidence of severe sapsucker attack (A. A. 250).

**CAMPBOR TREE** (*Cinnamomum camphora*).—Camphor trees which were abundantly punctured were observed at Gainesville, Fla., and at Abbeville, La., the writer was informed that two camphor trees planted near that town had been killed by sapsuckers.

#### THE SWEET GUM FAMILY (ALTINGIACEÆ).

Only one species of this family occurs in the United States. It is vigorously attacked by sapsuckers apparently throughout its range, but, so far as we know, is never killed.

**SWEET GUM** (*Liquidambar styraciflua*).—A tree in the Agricultural Department grounds has a great many girdles of sapsucker pecks. At the Santee Club, South Carolina, almost every sweet gum tree bears sapsucker work, the bark of some being perforated as thickly as possible from top to bottom. At Gainesville, Fla., a large proportion of the trees are abundantly punctured, and the tree seems as much a favorite at Abbeville, La.

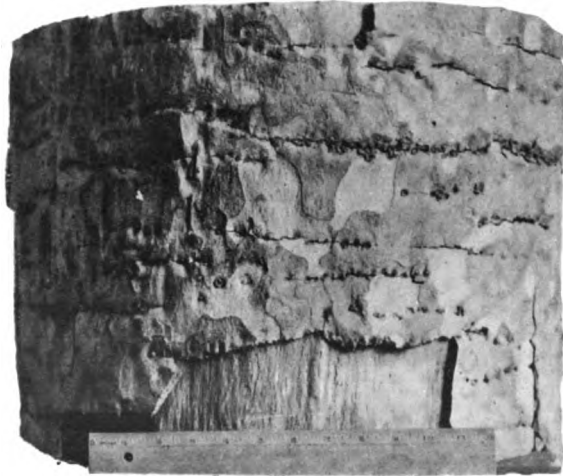


FIG. 7.—Sapsucker work on California sycamore (*Platanus racemosa*).

#### THE SYCAMORES (PLATANACEÆ).

Two of the three native species are attacked by sapsuckers, and although the work disfigures the smooth white bark, it is not known to decrease the vitality of the trees.

#### LIST OF PLATANACEÆ ATTACKED.

**SYCAMORE** (*Platanus occidentalis*).—Longbridge, La.

**CALIFORNIA SYCAMORE** (*Platanus racemosa*).—California (A. A. and A. M. 244). (Fig. 7.)

#### THE ROSE FAMILY (ROSACEÆ).

All of the five arborescent species of this family occurring in the United States are attacked by sapsuckers, and one (*Cercocarpus ledifolius*) is known to be much disfigured.

## LIST OF ROSACEÆ ATTACKED.

(*Vauquelinia californica*).—Arizona (A. A. 242).

MOUNTAIN MAHOGANY (*Cercocarpus betuloides*).—Arizona (A. A. and A. M. 203).

MOUNTAIN MAHOGANY (*Cercocarpus traskiæ*).—Santa Catalina Island, Cal. (A. A. 205).

MOUNTAIN MAHOGANY (*Cercocarpus breviflorus*).—Huachuca Mountains, Ariz. (A. M. 204).

MOUNTAIN MAHOGANY (*Cercocarpus ledifolius*).—Eureka, Cal. (A. A. 202).

## THE APPLE FAMILY (MALACEÆ).

This family contains trees of immense economic importance, as the pear, crab apple, and apple. Each of these is attacked by sapsuckers. Both kinds of apple trees are often killed and young orchards are sometimes ruined. The apple family includes also valuable ornamental trees, which are often injured or killed, especially the mountain ash. The harm done to the trees of this family weighs heavily in the case against the sapsuckers.

*Species of Malaceæ known to be attacked by sapsuckers.*

Genus.	Number of native species.	Native species attacked.	Introduced species attacked.
Mountain ash ( <i>Sorbus</i> ).....	1	1	
Pear ( <i>Pyrus</i> ).....	0	0	2
Apple ( <i>Malus</i> ).....	5	3	2
Service berry ( <i>A. melanochier</i> ).....	6	0	0
California holly ( <i>Heteromeles</i> ).....	1	1	0
Hawthorn ( <i>Crataegus</i> ).....	50+	10	2
	63+	15	6

Our information as to the number of species of hawthorn attacked must be far less complete than that concerning other genera. Species of this genus have been described in recent years by the hundred. A conservative author now recognizes 50 arborescent species in the Northeastern States, and as the genus seems to be a favorite with the sapsucker, it is probable that many more than the 10 species here recorded are attacked.

## LIST OF MALACEÆ ATTACKED.

MOUNTAIN ASH (*Sorbus americana*).—Bendire notes that the yellow-bellied woodpecker is "partial to the . . . mountain ash." Merriam says: "More than half the bark is sometimes removed from the girdled portions, and the balance dries up and comes off. Therefore it is not surprising that trees which have been extensively girdled generally die." Warren notes that "in one garden [in Racine, Wis.],

all the mountain ash . . . trees were entirely killed," and Dr. A. K. Fisher reports that sapsuckers killed a large mountain ash near Ossining, N. Y.

PEAR (*Pyrus communis*).—Hoy (1865) states that this species is attacked by the sapsucker, and J. M. Thompson says the pear is "one of its principal food trees."

OLIVE-LEAVED PEAR (*Pyrus elæagnifolia*).—Department of Agriculture grounds, District of Columbia.

CRAB APPLE (*Malus angustifolia*).—South Carolina (A. A. and A. M. 240).

CRAB APPLE (*Malus baccata*).—Widmann (see Bendire) says this species is occasionally punctured, and Horsford states that "the sour puckery crab apple seldom escapes." He also figures a crab apple tree which was killed by yellow-bellied sapsuckers.

CRAB APPLE (*Malus coronaria*).—Nazareth, Pa. (A. M. 239).

APPLE (*Malus malus*).—Everywhere in the United States, apparently, apple trees are subject to sapsucker attack (see Pl. V, fig. 3). The writer has noticed abundant sapsucker work on trees in Massachusetts, Maryland, the District of Columbia, and Virginia. Near Afton, Va., fully 90 per cent of the trees in an orchard of 40 acres had been pecked profusely. The apple tree is attacked in Indiana and in West Virginia (Hopkins) and many other places mentioned in the following notes, often with fatal results. Bendire says the sapsucker "materially injures and eventually kills many . . . trees. In southern Utah . . . it is said to do considerable damage to orchards in the early spring and again in fall, tapping the . . . apple trees for sap." Horsford says:

This is the most destructive bird in our climate. I have seen the best trees in an apple orchard destroyed. . . . Where the bird breeds, whole orchards are severely injured, if not destroyed, by them. . . . The flow of sap is so diminished that the leaves fade and the fruit withers on the stem or falls to the ground. Perhaps not half the apple trees attacked are killed outright. The injury is . . . in every possible degree, from the round "gimlet hole," which is not fatal, to the broad "countersink," which kills the branch or the whole tree.

Garfield notes that "an apple tree badly pecked ceases to bear for several years." Clifford states that they "do great damage to the apple trees . . . sometimes girdling them so as to kill them entirely," and George H. Selover writes: "The yellow-bellied woodpeckers . . . have been noticed very often in the act of picking through the bark of apple trees, and quite often have destroyed the trees" (Lake City, Minn., 1885).

CRAB APPLE (*Malus diversifolia*).—Oregon (A. M. 238).

CALIFORNIA HOLLY (*Heteromeles arbutifolia*).—A trunk collected in California is much deformed. One almost complete girdle of punctures retains the characteristic appearance, while elsewhere there are

irregular swollen ridges covered by roughly fractured bark, but showing traces of regularly placed holes (A. A. and A. M. 235).

HAWTHORNS (*Cratægus*).—Bendire says the sapsucker is "partial to the thorn apple," a statement fully justified. Out of a collection of 27 trunks of thorn trees in the American Museum, 13 were punctured. In the vicinity of Longbridge, La., practically all the haw trees (*Cratægus opima*) were pecked by sapsuckers, many of them showing swollen girdles.

#### LIST OF HAWTHORNS ATTACKED BY SAPSUCKERS.

(*Cratægus crus-galli*)—Marshall, Tex. (A. M. 229); (*C. punctata*)—Georgia (A. A. 226); (*C. lacrimata*)—Crestview, Fla. (A. M. 212); (*C. opima*)—Longbridge, La.; (*C. berlandieri*)—Columbia, Tex. (A. M. 219); (*C. boyntoni*)—Asheville, N. C., (A. M. 215); (*C. brazoria*)—Brazoria, Tex. (A. M. 224); (*C. collina*)—Asheville, N. C. (A. A. and A. M. 225); (*C. texana*)—Columbia, Tex. (A. M. 218); (*C. mollis*)—Dallas, Tex. (A. M. 220); (*C. marshalli*)—South Carolina (A. M. 211); (*C. monogyna*)—Smithsonian grounds, District of Columbia.

#### THE PLUMS AND CHERRIES (AMYGDALACEÆ).

This family, like the preceding, contains species of great commercial value—the peach, plums, and cherries. Two species of plums and one of cherry are known to be deformed by sapsucker work, and the cultivated peach and cherry are killed. Considerable damage is sometimes done to orchards of these trees.

#### Tabulation of Amygdalaceæ known to be attacked by sapsuckers.

Genus.	Number of native species.	Native species attacked.	Introduced species attacked.
Cocoa plum ( <i>Chrysobalanus</i> ).....	1	0	0
Peach, plum, and cherry.....	14	6	4
Grape cherries ( <i>Padus</i> ).....	8	2	0
Evergreen cherries ( <i>Laurocerasus</i> ).....	4	1	0
	27	9	4

#### LIST OF AMYGDALACEÆ ATTACKED.

ALMOND (*Amygdalus communis*).—Penryn, Cal. (Budgett).

PEACH (*Amygdalus persica*).—Henshaw says:

In civilized districts the injury and even destruction of fruit trees [by the sapsucker] caused by the tearing off of large pieces of bark with the apparent design of reaching the tender inner bark or juices of the tree place it on the proscribed list of the farmers. In southern Utah I visited peach orchards which had suffered severely from this cause.

Hoy (1852) notes that sapsuckers visit "the orchards during September and October to feed upon the inner bark of the peach . . . , girdling the stems so effectually as not infrequently to kill the trees."

HOG PLUM (*Prunus injucunda*).—Stone Mountain, Ga. (A. A. and A. M. 194).

WILD RED PLUM (*Prunus americana*).—Florida (A. M. 199); Illinois (F. 26424).

CHICKASAW PLUM (*Prunus angustifolia*).—Missouri (A. M. 197).

WILD GOOSE PLUM (*Prunus hortulana*).—Courtney, Mo. (A. M. 198).

GARDEN PLUM (*Prunus domestica*).—Illinois (F. 26423); Wisconsin, (Hoy, 1865).

CULTIVATED CHERRY (probably *Prunus avium*).—The sapsucker is "very fond of cherry sap" (J. P. Moore, Easton, Pa., Oct. 9, 1887). It "visits the orchards during September and October to feed upon the inner bark of the . . . cherry, girdling the stems so effectually as not infrequently to kill the trees" (Hoy, 1852).



FIG. 8.—Sapsucker work on bitter cherry (*Prunus emarginata*).

BITTER CHERRY (*Prunus emarginata*).—Oregon (A. A. 191). (Fig. 8.)

WESTERN CHOKE CHERRY (*Padus demissa*).—California (A. M. 190).

WILD BLACK CHERRY (*Padus serotina*).—Erie, Pa., Todd; Washington, D. C.; Randolph County, W. Va., (H. 6801a); Wisconsin, Hoy (1865); southern Arizona (A. A. and A. M. 188).

ISLAY (*Laurocerasus ilicifolia*).—California (A. A. and A. M. 185).

#### THE MIMOSA FAMILY (MIMOSACEÆ).

Fifteen species of this family become arborescent in the United States, only one of which, so far as known, is attacked by sapsuckers.

MESQUITE (*Prosopis glandulosa*).—Arizona (A. M. 174).

## THE SENNA FAMILY (CÆSALPINACEÆ).

Two of the 12 native species of trees of this family are attacked by sapsuckers, and one of them at least is much disfigured. One West Indian species also is punctured by the sapsucker.

## LIST OF CÆSALPINACEÆ ATTACKED.

**WATER LOCUST** (*Gleditsia aquatica*).—This tree is very commonly attacked by sapsuckers near Longbridge, La., and swollen girdles are produced similar to those figured for the honey locust.

**HONEY LOCUST** (*Gleditsia triacanthos*).—Near Longbridge, La., nearly every tree is attacked by sapsuckers and protruding girdles are usually formed. One tree (fig. 5 and Pl. IV, fig. 3) was remarkably deformed, having shelflike girdles, some of which extend halfway around the tree and project 4 inches.

**LOGWOOD** (*Hæmatorhylon campechianum*).—Bahama Islands, Moore.

## THE PEA FAMILY (FABACEÆ).

Ten arborescent species of this family occur in the United States, of which two are known to be attacked by sapsuckers.

## LIST OF FABACEÆ ATTACKED.

**LOCUST** (*Robinia pseudacacia*).—Randolph County, W. Va. (F. 73108).

**SONORA IRONWOOD** (*Olneya tesota*).—Arizona (A. M. 154).

## THE RUE FAMILY (RUTACEÆ).

Only one of the nine native arborescent species is known to be molested by the yellow-bellied sapsucker.

**SATINWOOD** (*Xanthoxylum flavum*).—Southern Florida (A. M. 150).

## THE MAHOGANY FAMILY (MELIACEÆ).

The single native tree of this family, the valuable mahogany, is attacked by sapsuckers.

**MAHOGANY** (*Swietenia mahogani*).—Dr. Hopkins obtained specimens of veneer made of Cuban mahogany at Indianapolis, Ind., which prove that the sapsucker attacks this tree. A trunk collected on one of the Florida Keys has numerous pecks in the bark (A. M. 141).

## THE SPURGE FAMILY (EUPHORBIACEÆ).

One of the four native arborescent species is attacked by sapsuckers.

**LARGE GUIANA PLUM** (*Drypetes diversifolia*).—Florida Keys (A. A. 140).

## THE SUMAC FAMILY (ANACARDIACEÆ).

Yellow-bellied sapsuckers attack one of the nine native trees of this family.

**SMOKE TREE** (*Cotinus americanus*).—Huntsville, Ala. (A. M. 136).

## THE HOLLY FAMILY (AQUIFOLIACEÆ).

The genus *Ilex* includes all (11) arborescent species of this family occurring in the United States. Five of these species are known to be attacked by sapsuckers, and at least one of them (*Ilex cassine*) to be killed. Nearly all the hollies are planted for ornament. The sapsucker pecking disfigures the smooth gray or white bark and sometimes results in the death of the trees.

## LIST OF AQUIFOLIACEÆ ATTACKED.

**HOLLY** (*Ilex decidua*).—Red River Valley, Ark., Hough.

**HOLLY** (*Ilex montana*).—Allegheny Mountains, N. C., Hough.

**HOLLY** (*Ilex cassine*).—Cottonport and Longbridge, La.

**YOUPON** (*Ilex vomitoria*).—Church Island, N. C.

**HOLLY** (*Ilex opaca*).—Matteson, Miss. (F.); Fannin County, Ga., November 29, 1909 (F.); Tennessee (A. M. 129); Abbeville, La.

## THE MAPLES (ACERACEÆ).

The single genus of this family in the United States consists of 21 species, 9 of which are attacked by sapsuckers, 2 sometimes being killed. Sapsucker work is recorded for 1 introduced species. Evidently in some localities maples are great favorites with the sapsuckers, and many valuable ornamental trees are killed.

## LIST OF ACERACEÆ ATTACKED.

**STRIPED MAPLE** (*Acer pennsylvanicum*).—Western Maine, Wm. Brewster; Lewis County, N. Y., Hough.

**SYCAMORE MAPLE** (*Acer pseudoplatanus*).—Smithsonian grounds, District of Columbia.

**SILVER MAPLE** (*Acer saccharinum*).—Illinois (F. 26411 and 26492); Indiana, Butler (1897).

**RED MAPLE** (*Acer rubrum*).—Bolles describes sapsucker work on the red maple as follows:

The drills made by the woodpeckers began 18 feet from the ground and formed a girdle entirely around the trunk. The girdle contained over 800 punctures and was about 3 feet in height. In places the punctures or drills had run together causing the bark to gap and show dry wood within. . . . The leaves on branches above the drills drooped; those below were in good condition.

Bendire says the bird "is partial to the . . . red . . . maple," and "Hermit" states that "red maples . . . were dead or dying"

as a result of the pecking. Specimens from Essex County, N. Y. (A. M. 110), and Illinois (F. 26494) also show sapsucker work.

RED MAPLE (*Acer drummondi*).—Cottonport, La.

SUGAR MAPLE (*Acer saccharum*).—Bendire states that the sapsucker "is partial to the . . . sugar maple," and Purdy calls it one of the bird's preferred food trees. Butler says:

Choice maples are seriously damaged. . . . I have counted six of these birds at one time on a dozen sugar maples . . . and have seen the sap flow in a stream.

John Brady, of Batavia, Ill., testifies that the sapsucker hurts hard maple trees (Sept. 29, 1885), and M. S. Giles, of Waukegan, Ill., reports that sapsuckers—

destroy more shade trees—particularly hard maple and linden—than any one thing that I know of. I set out hard maples on my place over 32 years ago and I have only succeeded in saving them by persistently killing the sapsuckers for the past 6 or 7 years—for it was only as far back as that I woke to the damage that those birds were doing to the trees. Twenty years ago this place was noted for the number of hard maple shade trees it had; to-day I can show you in my own immediate neighborhood dozens of trees that are destroyed, or partially so, from the work of the "sapsucker" [May 2, 1909].

Specimens from Morgantown, W. Va. (H.); Louisville, Ky., and Illinois, and Iron County, Mo. (F. 26493 and 72158), also show sapsucker work.

BLACK MAPLE (*Acer nigrum*).—Illinois (F. 26410).

WHITE-BARKED MAPLE (*Acer leucoderme*).—Boulden, Ga. (A. M. 113).

MOUNTAIN MAPLE (*Acer grandidentatum*).—Garfield County, Utah (A. M. 112).

BOX ELDER (*Acer negundo*).—Butler County, Mo. (F. 72128); Fairfax County, Va.; Longbridge, La.

#### THE BUCKEYE FAMILY (ÆSCULACEÆ).

But one of the six native arborescent species is known to be molested by sapsuckers and that but slightly.

OHIO BUCKEYE (*Æsculus glabra*).—Indianapolis, Ind. (H. 2423a).

#### THE BUCKTHORN FAMILY (RHAMNACEÆ).

Three of the 12 arborescent species of the United States are known to be attacked by sapsuckers. None are known to be injured severely, though the Indian cherry and the California lilac are undoubtedly disfigured.

#### LIST OF RHAMNACEÆ ATTACKED.

CASCARA SAGRADA (*Rhamnus purshiana*).—Seattle, Wash. (H. 174b).

INDIAN CHERRY (*Rhamnus caroliniana*).—Florida (A. M. 94).

CALIFORNIA LILAC (*Ceanothus thyrsiflorus*).—California (A. M. 91).

## THE BASSWOOD FAMILY (TILIACEÆ).

Four of the eight native trees of this family are attacked by sapsuckers and two introduced species. Swollen girdles are a characteristic result, sometimes greatly disfiguring these valuable ornamental trees. One species (*Tilia americana*) is known to be killed (see p. 46).

## LIST OF TILIACEÆ ATTACKED.

BASSWOOD (*Tilia americana*).—Randolph County, W. Va. (H. 6801); Waukegan, Ill., May 2, 1909, M. S. Giles; Wisconsin, Hoy (1865); Illinois (F. 26405 and 26490); Allenton, Mo. (A. A. and A. M. 88); Butler County, Mo. (F. 73188); Department of Agriculture grounds, District of Columbia; Plummers Island, Md.; Rockfish Valley, Va.

BASSWOOD (*Tilia heterophylla*).—Tennessee (A. A. and A. M. 87).

BASSWOOD (*Tilia michauxii*).—West Virginia (F. 74773).

BASSWOOD (*Tilia pubescens*).—Abbeville, La.; Florida (A. M. 86).

LINDEN (*Tilia europea*).—Department of Agriculture grounds, District of Columbia.

SILKY LINDEN (*Tilia tomentosa*).—Department of Agriculture grounds, District of Columbia.

## THE FREMONTIA FAMILY (CHEIRANTHODENDRACEÆ).

The single native representative of this family is attacked by sapsuckers.

FREMONTIA (*Fremontodendron californicum*).—San Jacinto Mountains, Cal. (A. A. and A. M. 85).

## THE TAMARISK FAMILY (TAMARICACEÆ).

The single introduced species is attacked by sapsuckers.

TAMARISK (*Tamarix gallica*).—Belle Isle, La.

## THE OLEASTER FAMILY (ELÆAGNACEÆ).

One introduced species of this family is known to be attacked by sapsuckers.

SILVER OLEASTER (*Elæagnus umbellata*).—Department of Agriculture grounds, District of Columbia.

## THE WHITE MANGROVE FAMILY (COMBRETACEÆ).

All the native species, three in number, are attacked by sapsuckers.

## LIST OF COMBRETACEÆ ATTACKED.

BUTTONWOOD (*Conocarpus erecta*).—Florida Keys (A. A. and A. M. 70).

BLACK OLIVE TREE (*Bucida buceras*).—Elliotts Key, Fla. (A. A. and A. M. 69).

WHITE MANGROVE (*Laguncularia racemosa*).—Florida Keys (A. M. 68).

#### THE MYRTLE FAMILY (MYRTACEÆ).

One of the seven native arborescent species is known to be attacked.  
SPANISH STOPPER (*Eugenia buxifolia*).—Key West, Fla. (A. M. 76).

#### THE DOGWOOD FAMILY (CORNACEÆ).

Six of the 10 native arborescent species are attacked by sapsuckers. None are known to be seriously injured.

##### LIST OF CORNACEÆ ATTACKED.

SOUR GUM (*Nyssa sylvatica*).—Dismal Swamp, Va., H. S. Barber.

TUPELO GUM (*Nyssa uniflora*).—Illinois (F. 26433).

OGECHE PLUM (*Nyssa ogeche*).—Georgia (A. M. 66).

CORNEL (*Cornus asperifolia drummondii*).—Columbia, Tex. (A. M. 62).

FLOWERING DOGWOOD (*Cynoxylon floridum*).—Illinois (F. 26429); Cottonport, La.

WESTERN DOGWOOD (*Cynoxylon nuttallii*).—Oregon (A. M. 63).

#### THE HEATH FAMILY (ERICACEÆ).

Two of the 13 arborescent species of the United States are attacked, one of which is severely injured.

SOURWOOD (*Oxydendrum arboreum*).—(A. A. and A. M. 55.)

MADROÑA (*Arbutus menziesii*).—A specimen collected by Dr. Hopkins at Grant Pass, Oreg., April 25, 1899, shows large continuous horizontal areas denuded of bark. After several years' growth the wood at the bottom of these wounds is still left exposed.

#### THE HUCKLEBERRY FAMILY (VACCINIACEÆ).

The single arborescent species of this family is attacked and patches of its bark are killed.

TREE HUCKLEBERRY (*Batodendron arboreum*).—At Cottonport, Longbridge, and Abbeville, La., this species is abundantly punctured by sapsuckers. Most of the trees have girdles of pecks and the bark is killed in spots. The healing is slow and difficult, leaving patches of dead wood exposed and the exterior of the tree considerably distorted.

#### THE SAPODILLA FAMILY (SAPOTACEÆ).

Two of the 11 native trees of this family are attacked by sapsuckers.

SOUTHERN BUCKTHORN (*Bumelia lycioides*).—Florida (A. A. and A. M. 45).

ARIZONA BUCKTHORN (*Bumelia rigida*).—Western Texas or Arizona (A. A. 47).

#### THE EBONY FAMILY (EBENACEÆ).

One of the two native trees is attacked by sapsuckers.

PERSIMMON (*Diospyros virginiana*).—Illinois (F. 26437); Cottonport, La.

#### THE STORAX FAMILY (STYRACACEÆ).

One of the two native arborescent species is attacked.

SILVERBELL TREE (*Halesia carolina*).—Fannin County, Ga., December 6, 1909 (F.).

#### THE OLIVE FAMILY (OLEACEÆ).

Seven of the 21 native ash trees are attacked by sapsuckers, one being seriously injured. Three other genera, each with one arborescent species, complete the list of trees of the United States belonging to the olive family. One of these, the devilwood of Florida, and one introduced tree are sometimes punctured.

#### LIST OF OLEACEÆ ATTACKED.

BLACK ASH (*Fraxinus nigra*).—Cranesville, W. Va. (H.).

ASH (*Fraxinus oregona*).—Oregon (A. A. 23).

BLUE ASH (*Fraxinus quadrangulata*).—Iron County, Mo. (F. 72388).

WATER ASH (*Fraxinus caroliniana*).—J. M. Thompson.

GREEN ASH (*Fraxinus pennsylvanica* var. *lanceolata*).—Georgia, West Virginia (F. 72372); Venice, La.

PUMPKIN ASH (*Fraxinus profunda*).—Butler County, Mo., June 2, 1908 (F.).

WHITE ASH (*Fraxinus americana*).—Bendire remarks that the sapsucker is partial to the white ash, and Bolles notes that it is "drilled for successive years" by sapsuckers and says "the forest trees attacked by them generally die." White ash trees near Cottonport, La., bore as many punctures as the bark would hold. Sapsucker work was abundant on white ashes at Abbeville, La., and specimens showing sapsucker injury have been examined from Illinois (F. 26439); Butler County, Mo. (F. 72438); Evansville, Ind., July 9, 1904 (H.); and Marion, Ind.

DEVILWOOD (*Osmanthus americana*).—Florida (A. A. and A. M. 21).

PRIVET (*Ligustrum* sp.).—Newport, Ark. (J. W. and J. M. Stayton, May 27, 1911).

## THE EHRETIA FAMILY (EHRETIACEÆ).

One of the five arborescent species of the United States is punctured by sapsuckers.

NOCKAWAY (*Ehretia elliptica*).—Texas (A. M. 17).

## THE TRUMPET CREEPER FAMILY (BIGNONIACEÆ).

Three of the five native arborescent species are attacked by sapsuckers.

## LIST OF BIGNONIACEÆ ATTACKED.

(*Catalpa catalpa*).—Smithsonian grounds, District of Columbia.

(*Catalpa speciosa*).—Allenton, Mo. (A. A. and A. M. 12); Illinois (F. 26441).

DESERT WILLOW (*Chilopsis linearis*).—Arizona (A. M. 14).

## THE MADDER FAMILY (RUBIACEÆ).

One of the seven native trees is attacked.

BUTTONBUSH (*Cephalanthus occidentalis*) (A. A.).

## THE HONEYSUCKLE FAMILY (CAPRIFOLIACEÆ).

Each of two genera of this family has five arborescent species in the United States. Of one, the elders, one species is known to be attacked and of the other, the black haws, three species. So far as known, none are seriously injured.

## LIST OF CAPRIFOLIACEÆ ATTACKED.

BLUE-BERRIED ELDER (*Sambucus glauca*).—Oregon (A. M. 4).

BLACK HAW (*Viburnum lentago*).—Missouri (A. A. and A. M. 3).

BLACK HAW (*Viburnum prunifolium*).—Georgia (A. A. and A. M. 1); Illinois (F. 26435).

BLACK HAW (*Viburnum rufidulum*).—Rome, Ga. (A. A. 2).

## TREES ATTACKED BY THE RED-BREASTED SAPSUCKER.

(*Sphyrapicus ruber*.)

## THE POPLARS AND WILLOWS (SALICACEÆ).

BLACK COTTONWOOD (*Populus trichocarpa*).—Bendire.

COTTONWOOD (*Populus fremonti*).—C. S. Thompson.

WEeping WILLOW (*Salix babylonica*).—"I have noticed no other trees [besides apple and pear] damaged except perhaps the weeping willow." (Ernest Adams, Clipper Gap, Cal., Apr. 30, 1909).

WILLOW (*Salix cordata*).—Vernon Bailey noted young *Sphyrapicus ruber* regaling themselves on willow sap at Donner Lake, Cal., July

25, 1900, and found many branches pecked on a number of willows. Mrs. Bailey (see bibliography), referring to the same instance, describes "lengthwise strips of bark . . . cut off, leaving fiddle-strings between." (See Pl. V, fig. 4.)

WILLOW (species not given).—A specimen of willow collected by Dr. A. K. Fisher at Tillamook, Oreg., shows almost all the bark removed from a fair-sized sapling.

#### THE WALNUTS (JUGLANDACEÆ).

ENGLISH WALNUT (*Juglans regia*).—The English walnut is very seriously injured (Ellwood Cooper, Santa Barbara, Cal., Jan. 22, 1909).

#### THE BIRCHES (BETULACEÆ).

BIRCH (species unknown).—Prof. F. E. L. Beal reports a white-barked birch so seriously injured at Salem, Oreg., that it appeared to be dying.

#### THE OAKS (FAGACEÆ).

CALIFORNIA BLACK OAK (*Quercus californica*).—All through the oak forests of the McCloud River country the black oaks were badly pecked (W. O. Emerson, Mar. 14, 1909).

CALIFORNIA LIVE OAK (*Quercus agrifolia*).—C. S. Thompson.

#### THE BARBERRIES (BERBERIDACEÆ).

BARBERRY (*Berberis* sp.).—C. S. Thompson.

#### THE SYCAMORES (PLATANACEÆ).

CALIFORNIA SYCAMORE (*Platanus racemosa*).—C. S. Thompson.

#### THE APPLE FAMILY (MALACEÆ).

MOUNTAIN ASH (*Sorbus sitchensis*).—"A species of mountain ash, on which none of the shoots were over 3 inches through, had been riddled all over by the birds" (Bendire).

MOUNTAIN ASH (*Sorbus* sp.).—Prof. F. E. L. Beal reports an arborescent mountain ash so seriously injured at Salem, Oreg., that it appeared to be dying.

PEAR (*Pyrus communis*).—The pear tree is attacked by the red-breasted sapsucker (W. O. Emerson, Haywards, Cal., Mar. 14, 1909). "A pear tree 50 or more years old stands within 20 feet of our house and the trunk and lower branches are covered with symmetrically arranged pits" (Ernest Adams, Clipper Gap, Cal., Apr. 30, 1909). At Blaine, Wash., "the sapsuckers do immense damage, especially to the pear trees" (Dawson and Bowles).

APPLE (*Malus malus*).—"Some apple trees [attacked by this species] died back at the top and did not thrive, so that I cut them down as useless" (Ellwood Cooper, Santa Barbara, Cal., Feb. 8, 1909).

Along in February and March this species does a good deal of tapping the apple trees, more particularly in old orchards isolated in outlying canyons and mountain flats. In one old apple orchard in Culls Canyon [near Haywards, Cal.] certain varieties of apple trees are badly girdled, as the bellflower, winter pearmain, and Baldwin. This I have noticed all through the Santa Cruz Mountains, where a good many apple orchards lay.

September 10, 1908, while on the McCloud River near Baird, Shasta County, I was in a small orchard patch of a dozen trees, situated in a deep ravine of the mountains, where no other orchards were in miles; these trees were the worst affected of any I ever saw by the *S. ruber* work. From within a foot of the ground up, all the main branches were literally cut up with their sap holes. It could plainly be seen where the trees had rapidly healed or grown up again and left the bark all pitted. No evil effect was noted as to small fruit, for I never saw finer sized nor colored apples in the coast counties. In a 10-mile drive from there to the railroad I observed wherever there grew an apple tree it was netted with *ruber's* sap holes. [W. O. Emerson, Haywards, Cal., Mar. 14, 1909.]

All the old [20 to 50 years] pear and apple trees are badly scarred up from the ravages of this bird. . . . I have removed numbers of the old apple trees which were affected. [Ernest Adams, Clipper Gap, Cal., Apr. 30, 1909.]

#### THE PLUMS AND CHERRIES (AMYGDALACEÆ).

PEACH (*Prunus persica*).—Mr. Carberry stated that if he did not keep these birds in check they would kill every fruit tree he owned. At least a dozen peach trees were scarred from top to bottom with small borings of this bird (J. H. Gaut, Burney, Cal., Aug., 1905).

APRICOT (*Prunus armeniaca*).—"It taps fruit trees, especially prune and apricot. . . . Trees are frequently killed by . . . punctures. . . . The evil . . . is wrought in summer when the dry season has enfeebled the tree" (Cook).

PLUM (*Prunus domestica*).—The plum is attacked by the red-breasted sapsucker (W. O. Emerson, Haywards, Cal., Mar. 14, 1909). See also quotation under Apricot, just above.

#### THE RUE FAMILY (RUTACEÆ).

ORANGE (*Citrus aurantium*).—"Some complaint has been made from Riverside and Los Angeles Counties of this species cutting the orange trees badly during the winter months" (W. O. Emerson, Mar. 14, 1909). Orange trees are very seriously injured (Ellwood Cooper, Santa Barbara, Cal., Jan. 22, 1909).

#### THE SUMAC FAMILY (ANACARDIACEÆ).

PEPPER TREE (*Schinus molle*).—The red-breasted sapsucker is "oftenest noticed, even along the noisy city streets, in the pepper trees, the sap of which this bird seems to particularly like" (Grinnell, 1898).

## THE MYRTLE FAMILY (MYRTACEÆ).

**BLUE GUM** (*Eucalyptus globulus*).—This species is injured by the red-breasted sapsucker (Ellwood Cooper, Santa Barbara, Cal., Jan. 22, 1909). "A number [of sapsuckers] have taken a fancy to a big blue gum tree in the yard, where on warm, sunny days they . . . go to peck holes and suck the rich sap that flows freely in the cold fall months" (Emerson).

## TREES ATTACKED BY THE WILLIAMSON SAPSUCKER.

(*Sphyrapicus thyroideus*.)

**BULL PINE** (*Pinus ponderosa*).—"Many grills of borings were seen in the bark of yellow pines and firs at Bluff Lake [Cal.] which I ascribed to this species" (Grinnell, 1908). A specimen from Pine Grove, Mont., collected by Joseph Brunner (II. 8516), is riddled with pecks, vertical strips of bark being cleanly removed.

**LODGEPOLE PINE** (*Pinus murrayana*).—Belding remarks that Williamson sapsuckers were "breeding in living tamaracks and covered with their resinous juices," which implies that the trees were tapped.

**PINE** (species not given).—Merrill notes that this sapsucker is "partial to young pines, with the soft inner bark of which, and fragments of insects, the stomachs of adults are usually filled."

**WHITE FIR** (*Abies concolor*).—See quotation from Grinnell under Bull pine.

## SUMMARY OF INJURIES JEOPARDIZING THE VIGOR OR LIFE OF TREES.

Condensing the information contained in the foregoing lists, we find that the yellow-bellied sapsucker attacks no fewer than 246 species of native trees and 6 vines, besides 31 kinds of introduced trees. Twenty-nine of these trees and 1 vine are known to be sometimes killed and 28 others are much disfigured or seriously reduced in vitality.

The red-breasted sapsucker, a bird much less observed, is known to attack 20 species of trees and shrubs, to damage individuals of at least 11 of them, and sometimes to kill members of 8 species. Considering the smaller range of this sapsucker and our comparative unfamiliarity with its habits, there is little doubt that bird for bird it is fully as detrimental to trees as the more widespread yellow-bellied woodpecker.

The Williamson sapsucker is here recorded as attacking 3 species of the pine family.

Combining the statistics for the 3 species of sapsuckers, we find that they are known to attack 258 trees, shrubs, and vines of 45 native families. These families are represented by 603 arborescent

species in the United States, of which 248 are known to be punctured by sapsuckers. Thirty-eight introduced species are attacked, which belong to 17 families, 3 of which have no native representatives. Sixty-three of the total number of trees and shrubs are seriously damaged by sapsuckers and 31 of them, besides 1 vine, are known to be killed. There are 31 families of plants having native arborescent species in this country, and 7 wholly introduced families, no member of which is known to be attacked by sapsuckers. However, these families average less than 2 species each, while the native families, including the 258 species attacked, contain an average of 14 species each, so that our negative results for the former group are probably due in great part merely to the small amount of material examined rather than to the sapsuckers' distaste for trees of these families.

Indeed it seems probable that practically all trees accessible to sapsuckers will sooner or later be attacked. The only widespread and numerous trees not yet known to be punctured are the mulberries, Osage orange, and figs (family Moraceæ), and the palms and yuccas belonging to the endogenous subclass of plants, in which the circulation of sap is peculiar, which are presumably unsuited to sapsuckers.

The evidence shows that the three species of sapsuckers have practically the same habits and consequent injurious effects upon trees. However, the Williamson sapsucker is not now known to harm trees of great value. Leaving this species out of consideration and speaking only of the red-breasted and yellow-bellied sapsuckers, the above detailed testimony abundantly confirms the conclusion drawn from the anatomical structure and stomach examination, namely, that sapsuckers habitually feed upon bast, cambium, and sap. It further shows that in securing their favorite food they often remove so much of the growing layer of trees that the vigor of the latter is impaired, sometimes to such a degree that death ensues.

However strong seems the indictment against the sapsuckers, it must not be imagined that every tree pecked by them is doomed. On the contrary, they frequently work on a tree year after year without noticeably diminishing its vitality. Near Washington the writer has noted large elms whose trunks have evidently been attacked by many generations of sapsuckers and are freely drilled every year, but which to all appearances are now in perfect health. W. A. Taylor, of the Division of Pomology in the Department of Agriculture, states that at his home in southwestern Michigan there are several apple trees, now over 70 years old, which are known to have been yearly drilled by sapsuckers without diminishing their vigor or productiveness. The western half of the Department of Agriculture grounds at Washington contains 232 trees, of which 56 have been attacked by sapsuckers.

Only one of these gives external evidence of injury, an English walnut, one limb of which has been partly killed, and only a few are noticeably disfigured.

While there is no doubt that trees may be freely attacked by sap-suckers without their lives being endangered, it is equally true that many trees, including valuable orchard and ornamental specimens, are seriously injured or killed by these woodpeckers. The owners of such trees have every right to protect them and should be given legal authority to do so.

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## EFFECTS OF SAPSUCKER WORK ON LUMBER AND FINISHED WOOD PRODUCTS.

### INTRODUCTION.

Those relations of sapsuckers to trees which are detrimental to man's interest are by no means confined to the external disfiguration, the weakening, or killing of trees. Indeed in the aggregate sapsuckers inflict much greater financial loss by rendering defective the wood of the far larger number of trees which they work upon moderately but do not kill. Blemishes, reducing the value, appear in the lumber from such trees and in the various articles into which it is manufactured.

These defects consist of distortion of the grain, formation of knotty growths and cavities in the wood, extensive staining, fat streaks, resin deposits, and other blemishes. All of them result from injuries to the cambium, their variety being due to differences in the healing. Besides blemishes, ornamental effects are sometimes

produced during the healing of sapsucker wounds, such as small sound stains, curly grain, and a form of bird's-eye.

The earliest communication we have on this point is from Charles Eshorn, jr., of Medora, Ind. On May 27, 1892, he wrote to the Biological Survey as follows:

[The sapsucker] ruins a great deal of valuable forest timber, namely, oak and hickory, by pecking holes. . . . As the tree grows these places decay, which renders the timber unfit for spokes, staves, etc. These birds are not very numerous, but it seems that each individual can do a great deal of mischief, and should the country be over-run with them they would be a great drawback to the timber business.

The relation of sapsuckers to lumber was first studied by Dr. A. D. Hopkins while he was connected with the West Virginia Agricultural Experiment Station. He discovered that curly and bird's-eye wood are often caused by injuries to living trees by woodpeckers. Dr. Hopkins read a paper on the subject before section F of the American Association for the Advancement of Science,<sup>1</sup> and another before the American Forestry Association in August, 1894, and he spoke on the same subject at a meeting of the Biological Society of Washington March 25, 1902. Dr. Hopkins has generously turned over to the Biological Survey the manuscript and photographs illustrating the latter communication, in addition to his large collection of wood samples showing woodpecker work. This collection, augmented by material gathered by the writer in the field or examined in various museums, forms the basis of this section of the bulletin.

In his address on "Ornaments and blemishes in wood caused by insects and birds,"<sup>2</sup> Dr. Hopkins says:

Blemishes or defects appear in lumber and wood finish as discolored spots, checks, dark stains, resin deposits, pinholes, wormholes, etc., and in the trees as scars, decayed spots, and hollow trunks.

Ornamental conditions appear in the lumber and inside finish and furniture as so-called bird's-eye, curly, burl, and wavy or satined effects and on the surface of the wood beneath the bark as artistic and curious carved and embossed work.

Twenty or thirty years ago, when the choicest material could be selected from an abundant and cheap supply, blemishes were rarely seen, even in the cheaper finished products. Within recent years, however, the supply of choice lumber free from defects is becoming so scarce that none but the most expensive finished articles are entirely free from them. Indeed, it would be difficult to find a recently constructed public building or private residence which does not show in the natural wood finish one to many blemishes, the result of various causes. Most of them which are not natural conditions in the wood are caused primarily by insects, birds, mammals, and various other agencies which produce wounds in the cambium of the living tree.

<sup>1</sup> Hopkins, A. D., Some interesting conditions in wood resulting from the attack of insects and woodpeckers. Proc. Am. Assn. Adv. Sci. 1894, p. 252 [abstract]. Excerpts from this paper were published by Dr. Hopkins under the title "The Relation of Insects and Birds to Present Forest Conditions," in *Garden and Forest*, VII, 348 and 373, 1894. Its subject matter was brought before the Biological Society of Washington by Prof. C. V. Riley, Dec. 15, 1894, in a paper entitled "Some Interesting Results of Injuries to Trees;" and a review by H. C. Hovey appeared in the *Scientific American*, LXXI, 163, 1894.

<sup>2</sup> Meeting of Biol. Soc. Wash., Mar. 25, 1905.

The condition in wood of various kinds resulting from the everywhere common work of the class of woodpeckers known as sapsuckers in the bark of forest and cultivated trees has been the subject of special interest to me for many years, and my work on forest insects has naturally offered a good opportunity for observations and the collecting of specimens. The material collected represents some 40 species of forest trees of many genera and families and from widely differing sections of the country.

It appears that the object of the sapsucker working in the bark of living trees is to secure both liquid and solid food from the sap, cambium, and bast, and not for the purpose of collecting insects, or at least not primarily for that purpose. The punctures in the bark vary in size, form, and arrangement according to the species of tree and the character of the food furnished. In the pine, spruce, hemlock, juniper, and probably in all conifers, the desirable substance is furnished by the living bast tissue and cambium, while the wood yields resin instead of sap; therefore the birds have no occasion to puncture the outer wood ring and very rarely do so, whereas in maple, walnut, hickory, and such trees as furnish at certain times of the year a profuse flow of saccharine sap from the sapwood the outer ring of wood is generally punctured. In the former the wounds are usually broad, often connected, and arranged in longitudinal rows,<sup>1</sup> while in the latter they are narrow, funnel-shaped, rarely joining, and arranged in transverse rows. The method of healing of these wounds is quite variable, being influenced not only by the character of the wound but by the species or class of trees in which they occur. The resulting defective or ornamental conditions and subsequent annual layers of wood also vary in character and economic importance with different kinds of trees and commercial products.

The way in which sapsucker pecks are healed and the characteristic blemishes and ornamental effects produced may best be understood by the detailed consideration of these effects in a tree in which they are well marked. For this purpose the sugar or hard maple<sup>2</sup> (*Acer saccharum*) is selected, a favorite tree of the sapsuckers and one often seriously injured by them. The punctures sometimes penetrate only to the sapwood, but generally they pierce one or more annual rings. Whatever the character of the original wound, more or less staining, varying from light yellow to dark brown in color, takes place in its vicinity and sometimes extends several inches up and down the grain. The greater the injury to the sapwood the more extensive is the stain. When the sapsucker's drill extends only to the sapwood, distortion of the wood healing the wound is usually at a minimum. It can make excess growth only by bulging out into the hole in the bark. Upon the extent of this swelling depends the amount of abnormality in succeeding annual rings.

Figure 9A of the excellent series furnished by Dr. Hopkins illustrates this type of healing. Here the excess growth was small and would probably have been smoothly covered by the next annual layer, though a second stain would have been produced owing to

<sup>1</sup> Probably the contour of the bark has much to do with the arrangement of punctures. Conifers often have very thick bark but with longitudinal cracks where the wood can be more quickly reached. Vertical series of pecks occur on deciduous trees also, especially upon those having long ridges or strips of thick bark with furrows between.

<sup>2</sup> The specimens of hard maple here discussed were collected at Morgantown, W. Va. (Hopkins), and in Illinois (F 26493).

exposure of the cambium. Figure 9B further shows the results of failure to close the hole in the bark and to cover the original wound, thus leaving the sapwood exposed and liable to increased staining. A cone of cambium and bast has formed over the bottom of the peck, which will persist permanently as a rounded protuberance and over which all succeeding wood layers will be molded. A condition similar to this in a specimen having one layer of sapwood excavated is shown in the next figure (fig. 9C). The wound is not closed, the wood is left exposed, and if the healing has been completed for the season, an inwardly projecting cone will be left as before which will affect the form of future annual rings. Figure 9D shows a specimen in which two rings of sapwood have been punctured and the next year's growth has been vigorous, filling the original wound and pushing out into the hole in the bark. Succeeding wood layers

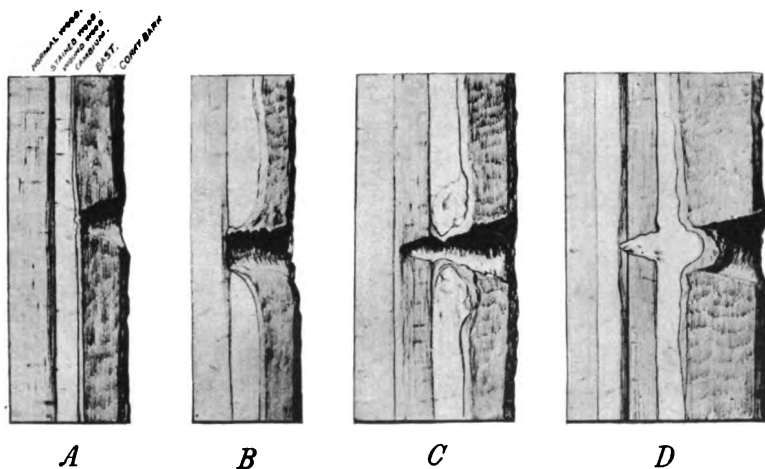


FIG. 9.—Effects of sapsucker work on wood of sugar maple (*Acer saccharum*). (From Hopkins.)

would be bent outward over the protuberance which partly fills the wound. The conditions in wood which has made several years' growth since the original injuries is shown in figures 10A and 10B. Both illustrate specimens in which the sapwood was punctured and extensive staining has resulted. In one case vigorous growth followed the injury and the healing has taken place as in figure 9D, with the result that the annual layers of wood are bent outward over the wound. The other specimen gives evidence of weaker growth, only partly filling the original hole and not pushing out into the bark opening. Hence the more vigorous new bast pushed into the vacancy, forming a protuberance on the inner side of the bark, between which and the depression over the original wound the next layer was formed. In consequence the latter also was bent inward and so was every succeeding layer.

To recapitulate, figures 9A to 9D show wounds 1 year old healed in various ways. Least progress is shown in B and C, in both of which the wound has failed to close. A conical projection is formed on the inside of the bark, which makes a deep depression in following wood layers, as is illustrated by figure 10A. Figures A and D show wounds promptly closed by more vigorous growth. In figure A, as the peck extended only to the sapwood, the succeeding annual layer is smooth internally and because of small growth only slightly distorted externally under the bark hole. In figure D one ring of sapwood is entirely and another partly pierced. The new growth has been so thrifty that the original peck has been filled and a plug also pushed out into the bark opening. Methods of healing as illustrated by figures 9A, 9D, and 10B produce a pit on the

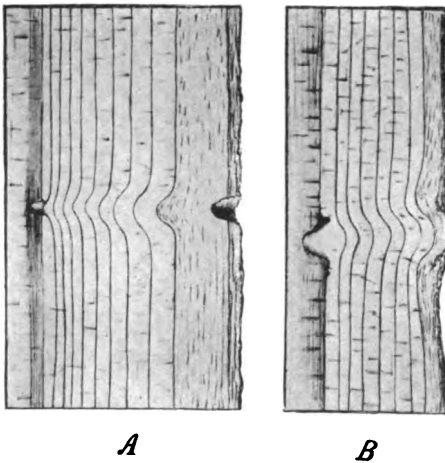


FIG. 10.—Effects of sapsucker work on wood of sugar maple (*Acer saccharum*). (From Hopkins.)

inner side of the bark which causes corresponding elevations in succeeding layers of wood. As a rule, then, if the growth following sapsucker wounds is vigorous, succeeding layers of wood will be bent outward over the wound; if weak, the grain will bend inward. In either case radial sections (fig. 10) of the wood reveal the curl in the grain and tangential sections cutting through the curls show a condition resembling natural bird's-eye (Pl. IX, fig. 6). As it can usually be recognized from the arrangement of the bird's-eyes in rows (see Pl. XII) corresponding to the well-known type of sapsucker work in the bark, it may well receive the name of sapsucker bird's-eye.

The question now arises, What is the effect of sapsucker work upon the commercial value of hard maple wood? The bird's-eye and curl, and even small stains if hard and sound, may be considered as ornamental and as enhancing the value of the wood. But extensive staining, a common accompaniment of sapsucker work in hard maple, is detrimental. Furthermore, the original pecks, if on the surface, appear as cavities surrounded by bleached and stained wood (Pl. IX, fig. 4), which must be planed off before the wood can be put to decorative use. The strength of the wood is not greatly affected except when pecks are numerous in a single annual layer, in which case this layer constitutes an easy splitting plane.

The failure of the original wounds to close or the formation of loose, knotty, and gnarled tissue, together with excessive staining, are serious defects which greatly reduce the market value of the lumber, as may readily be seen from the following definition of the grades of maple lumber:

*Firsts.*—Firsts must be 8 inches or over wide, 10, 12, 14, and 16 feet long, and free from all defects, except in pieces 10 inches or over wide, which may have one sound standard defect.

*Seconds.*—Seconds must be 6 inches or over wide, 8 to 16 feet long; pieces 8 feet long must be clear. . . .

*No. 1 commons.*—No. 1 commons must be 3 inches or over wide, 6 to 16 feet long; pieces 3 or 4 inches wide must have 1 face clear.—[Inspection rules, National Hardwood Lumber Association.]

It is evident that lumber sawn from a maple abundantly punctured by sapsuckers would not fare well at an inspection. Very few, if any, clear pieces of the sizes above specified, the smallest of which is 3 inches wide by 6 feet long, could be obtained from such a tree. Hence most of the lumber would be classed as No. 2 common, the fourth market grade, which means a heavy loss.

The effects of sapsucker work in other trees are more or less similar to those in hard maple, but vary according to the extent of injury and the habits of growth of the tree. For instance, the defects are usually much more pronounced in trees in whose bark holes remain open long, whether owing to slow growth or other reason. On the other hand, trees of rapid growth quickly heal and the blemishes are small and soon deeply buried. Wood with especially porous grain is extensively stained, while dense wood is less affected.

Defects due to sapsucker work are sufficiently similar in a general way, however, to be identifiable in any wood. On the end of logs, healed sapsucker wounds or bird pecks, as they are commonly called, appear as larger or smaller stains with more or less open fissures or checks extending a short distance toward the bark. The general effect is that of T-shaped or triangular marks or cavities surrounded by more or less stain. Several usually occur along the same wood ring (see figs. 24, 29, 33, 37; Pl. VIII, fig. 2; Pl. X, fig. 3). The checks may be continuous, in which case they constitute a defect known as rind gall (see figs. 30 and 35). In longitudinal section, as in most boards and in quarter-sawn or sliced material, bird pecks usually appear as small knots (also often T-shaped—figs. 15, 16, and 23) around which is a greater or less amount of stained wood. They are easily distinguished from true knots, however, which are due to adventitious buds and embedded bases of twigs and limbs. The gnarly or curled growth caused by bird pecks is all on one side of a line of separation between annual rings (see figs. 15, 17, 22, and 23). In

other words, the distortion of grain is confined to a half circle. An ordinary knot has no such definite relation to the wood layers, and is likely to be approximately circular in section. In rotary cut material and of course occasionally in ordinary lumber (longitudinal sections), bird pecks are cross sectioned, and generally show as transverse oblong holes, sometimes filled with loose wood, from which stains run up and down the grain (see figs. 11, 18, and 20). It is probable that the wounds made in trees by other woodpeckers sometimes heal so as to present the same appearance as sapsucker pecks; but these generally occur only as isolated blemishes, not in series, as sapsucker pecks nearly always do. Sapsucker pecks vary in economic bearing in different trees according to their abundance, the character of defects and ornaments produced, the uses to which the lumber is put, and its value.

#### WOODS IN WHICH BLEMISHES OR ORNAMENTAL EFFECTS ARE KNOWN TO RESULT FROM SAPSUCKER WORK.<sup>1</sup>

##### THE YEW FAMILY (TAXACEÆ).

Defects due to sapsucker pecking have been observed in two species of this family. In the stinking cedar they are unimportant. In the Florida yew, however, their nature and extent are such as to ruin both the appearance and the strength of the wood. They consist of small (one-fourth inch) black stains, accompanied by open knotty checks, gnarly grain, and long, open resinous seams, which in some cases constitute a complete cleavage between annual layers very similar to the defect known as cup shake.

##### THE CONE-BEARING TREES (PINACEÆ).

This family includes the most important timber trees of the United States. We find defects produced in the wood of 29 of the 90 native species. Ordinarily these defects vary from small to extensive brown or black, often transverse, stains to open checks up to an inch and a half in length, accompanied by fat streaks, resin deposit, and curled or gnarly grain in the wood layers overlying the healed punctures. Such defects have been observed in the following 12 species: White bark pine, lodgepole pine, long-leaf pine, scrub pine, red spruce, tideland spruce, eastern hemlock, Douglas fir, red fir, and three species of

<sup>1</sup> In this list the family summaries give general conclusions regarding defects. Full accounts are given of species showing typical or severe injuries, and the treatment of each family closes with a list of all the species in which blemishes or ornaments have been observed.

Where no locality or museum collection is cited, the specimens referred to are those given in the list of trees injured or killed (pp. 21-53). Where several specimens of a species are mentioned in that list, the particular specimens discussed here are indicated by citation of the locality or museum initials. The species recorded do not indicate the total damage done to lumber by sapsuckers, as we have been able to examine wood specimens showing defects in only 70 per cent of the species known to be attacked by sapsuckers, and that list is by no means complete.

white firs. The injuries are sufficient to keep lumber containing them out of the better grades used for finishing purposes. This involves the loss of a large percentage of the selling price, and the damage may reach serious proportions, as trees of this family are sometimes vigorously attacked. While the ordinary defects in the wood are undoubtedly a source of weakness in small pieces, they are of no account in large beams and other heavy construction material, for which these woods are much used. The long-leaf pine and white fir described below illustrate defects of this character.

Sapsuckers render certain woods of this family valueless for even coarse construction. They remove large areas of bark, usually in narrow vertical strips, and the injuries are so extensive as to leave cleavage places in the wood. Defects of this character have been observed in bull pine, pitch pine, Engelmann spruce, and western hemlock.

Injuries less extensive, but important because of special uses of the lumber, are described below for red cedar and cypress. In Monterey cypress and desert juniper the small black checks and brown stains are sound or accompanied by so much curled grain and bird's-eye that they embellish the wood.

Sapsucker wounds afford favorable conditions for the entrance and growth of a fungus (*Peridermium cerebrum*) which produces large galls on pine trees. When abundant, these galls so distort the trees that they become useless for lumber. Observations upon scrub and short-leaf pine show that not infrequently the fungous attack begins in sapsucker wounds.

**LONG-LEAF PINE** (*Pinus palustris*).—Black stains with resin deposit are produced about sapsucker wounds in this wood, and lighter stains extend some distance along the grain. These shade off into fat streaks, which may permeate many layers of wood and reach far up and down the grain. Figure 11 shows the appearance of healed bird pecks in this pine. The illustration of the tangential section does not show as extensive staining as is sometimes present. The cavities there delineated are filled with resin. (Specimens from Baldwin, Fla.; Boardman, N. C.; and Buna, Tex.) A specimen from Florida (A. M. 485) shows a series of very extensive pitch streaks half an inch in thickness and 3 to 4 inches long in one direction from the wound. Blemishes in the long-leaf pine are serious enough to keep the lumber out of finishing grades.

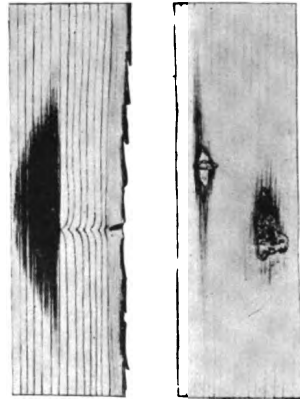


FIG. 11.—Effects of sapsucker work on wood of long-leaf pine (*Pinus palustris*). Radial and tangential sections. (From Hopkins.)

**WHITE FIR** (*Abies concolor*).—The defects are one-fourth to 1 inch long, filled with resin deposit and giving rise to fat streaks extending a foot or more along the grain. Many layers of wood over the wound have curly grain. The blemishes are of no consequence for coarse structural work, but destroy the value of the wood for ornamental purposes (Oregon, A. M. 444).

**WESTERN HEMLOCK** (*Tsuga heterophylla*).—A specimen of this wood collected at Detroit, Oreg. (H.), shows reddish to black resinous scars 1 to 3½ inches long, and the wood immediately over the wound gnarled and distorted, and one or two annual rings impregnated with a black crystalline resin deposit. The smaller blemishes produced by sapsucker work are practically identical with those described by H. E. Burke as black check, which is caused "by an injury to the cambium

... by the hemlock bark maggot, *Cheilosia alaskensis*."

Mr. Burke says: "Timber badly affected with this defect is nearly worthless for finishing, turning, staves, and woodenware, for which it would otherwise be excellent."<sup>1</sup> But injuries by sapsuckers generally occur on a larger scale and consequently are more damaging. Specimens of western hemlock collected by Mr. Burke

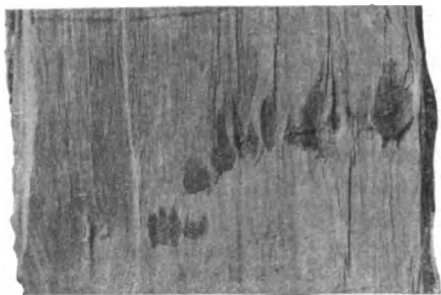
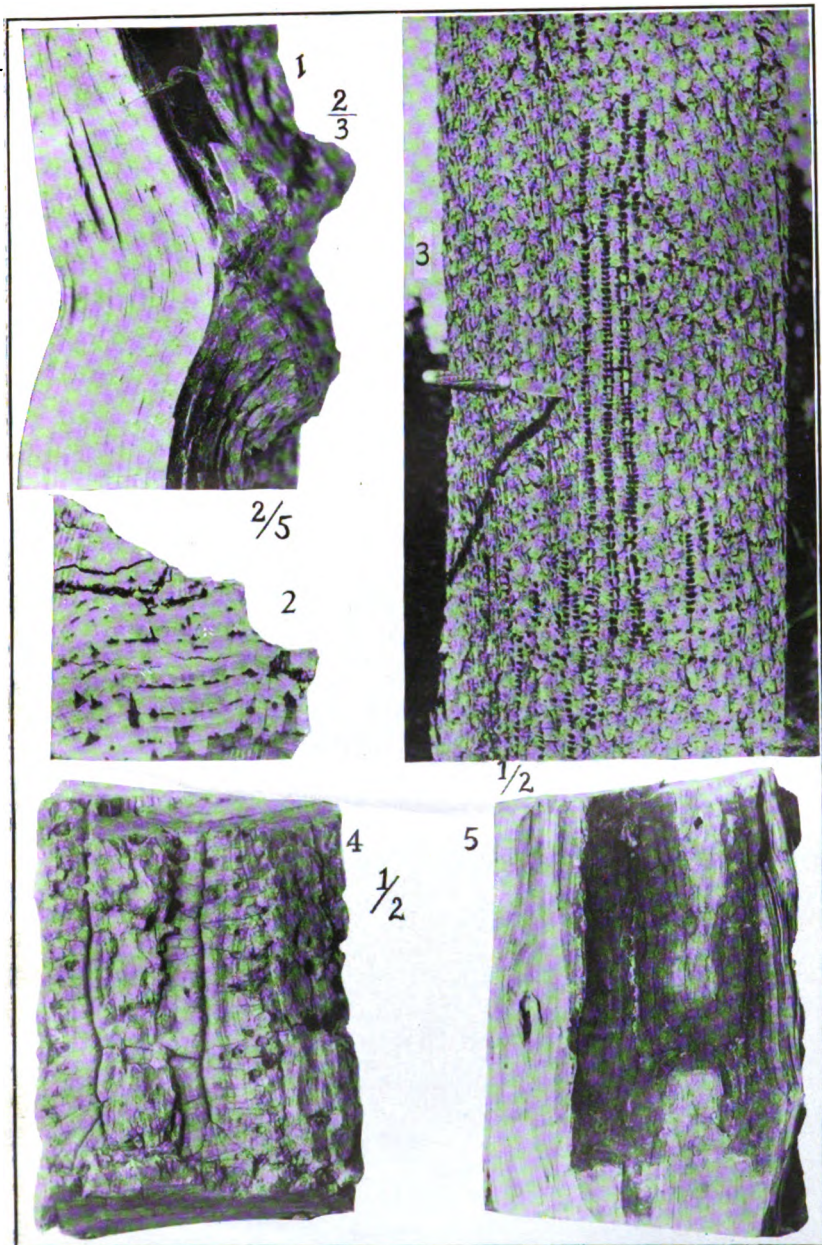


FIG. 12.—Effects of sapsucker work on wood of bald cypress (*Taxodium distichum*). Checks and stains.

at Hoquiam, Wash. (H. 2167a), show the removal by sapsuckers of long vertical strips of bark, exposing the sapwood (Pl. VIII, fig. 3). This weathers to a dark color and when healed over persists as a darkly stained area from 2 to 3 inches wide and up to several feet long with more or less resin deposit, making a thin brittle layer in the wood along the plane of which splitting easily occurs (Pl. VIII, fig. 5). The defect is extreme, both as to weakness and unsightliness, and when abundant and scattered throughout the wood, as sapsucker blemishes usually are, must render the wood valueless for all structural purposes. Besides the direct injuries to western hemlock by sapsuckers, their pecks in the bark furnish entrance to bark maggots.

**BALD CYPRESS** (*Taxodium distichum*).—Specimens from Boardman, N. C. (H.), show dark stains produced by sapsucker wounds in cypress and distortion of the grain in several annual rings, some of which give a bird's-eye appearance in tangential section. Pieces of cypress from Cottonport, La., have numerous black stains (fig. 12) from one-fourth to 1½ inches in length and often nearly contiguous. In some cases the holes drilled by the sapsuckers have not healed readily and have left

<sup>1</sup> Bureau of Entomology, Circular No. 61, p. 1, 1905.



WORK OF SAPSUCKER ON WHITE ELM AND WESTERN HEMLOCK.

[1, Radial section through swollen girdle on white elm, showing strong curl of grain. 2, Cross section; checks and stains. 3, Long vertical series of punctures in western hemlock. By H. E. Burke. 4, Exterior view of healed-over wounds of similar nature. 5, Interior view; extensive stain.]



open checks. Some of these form a narrow open knot an inch long. Distorted grain is very abundant and ranges from ornamental bird's-eye to abundant bunches of gnarls (fig. 13), which ruin the appearance and workability of the wood.

At Cottonport, La., the writer had an opportunity to learn what proportion of the wood of cypresses abundantly punctured by sapsuckers is defective. Out of 189 palings split from one cypress, 29, or nearly 16 per cent, bore enough black stains to ruin the wood for any ornamental purpose. In a lot of 322 palings, 111, or nearly 39 per cent, showed much gnarled grain accompanied by a few black spots. The gnarly wood and open knots are most objectionable in cypress, which is much used for purposes requiring easy working qualities and strength in slender pieces—for instance in greenhouse construction.

**NORTHERN RED CEDAR** (*Juniperus virginiana*).—Sometimes open fissures extend from checks toward the bark, surrounded by stain and gnarly wood. Even more objectionable are cases where the grain of the wood about the healed punctures is very wavy and each



FIG. 13.—Effects of sapsucker work on wood of bald cypress (*Taxodium distichum*). Gnarly grain.

scar has one or more outwardly projecting tubercles (fig. 14, and Pl. XI, fig. 3), varying up to an inch in length, and requiring at least two complete annual rings of wood to bury them. These tubercles, together with the gnarled grain and extensive resin deposit, produce a hard, knotty, brittle layer of wood. The wounds have small cavities and light but continuous stains. Wood thus disfigured is unsightly and unworkable. The greater part of the output of red cedar is used for pencil wood, for which the requirements are very exacting. A soft wood, even and straight grained, free from defects, is essential.<sup>1</sup> Trees of this species are very commonly worked on by sapsuckers, and often they are covered with rings of pecks. The writer found 19 out of 40 trees punctured on a small area on Plum-

<sup>1</sup> White, L. L., Circular 102, Forest Service, p. 5, 1907.

mers Island, Md. It is evident that considerable loss may be occasioned by the work of sapsuckers on red cedar. (Specimens from Plummers Island, Md.; Kanawha Station, W. Va. (II.); Illinois (F. 26487); and Florida (A. M. 417).)



FIG. 14.—Effects of sapsucker work on wood of red cedar (*Juniperus virginiana*). Radial and tangential sections. (From Hopkins.)

**SPECIES OF PINACEÆ BLEMISHED.**—Whitebark pine, nut pine, bull pine (by Williamson sapsucker, H. 8516), lodgepole pine, long-leaf pine, pitch pine (H.) (Pl. XI, fig. 2), scrub pine, red spruce (H.); Engelmann spruce, weeping spruce, tideland spruce, eastern hemlock (H.), western hemlock, Douglas fir, *Abies concolor*, *A. grandis*, *A. amabilis*, *A. magnifica* (fig. 15), *A. nobilis*, big tree, bald cypress, incense cedar, canoe cedar, Monterey cypress, Macnab cypress, white cedar (H.), desert juniper, western juniper, and northern red cedar.

#### THE POPLARS AND WILLOWS (SALICACEÆ).

The defects due to sapsucker work on poplar vary from small, slightly stained checks to large open knotty cavities, bordered or partly filled with decayed wood. Sometimes these checks cause the development of adventitious buds, thus making true knots. Over these, as well as over the normally healed pecks, are curls in the grain, which in some cases are duplicated through a great many annual layers (fig. 16). These ornament the wood, but it is doubtful if they counterbalance the disadvantage of the many large checks. The latter unfit the wood of black cottonwood, tacomahac, and Carolina poplar for one of its principal uses—the manufacture of tubs, barrels, and woodenware.

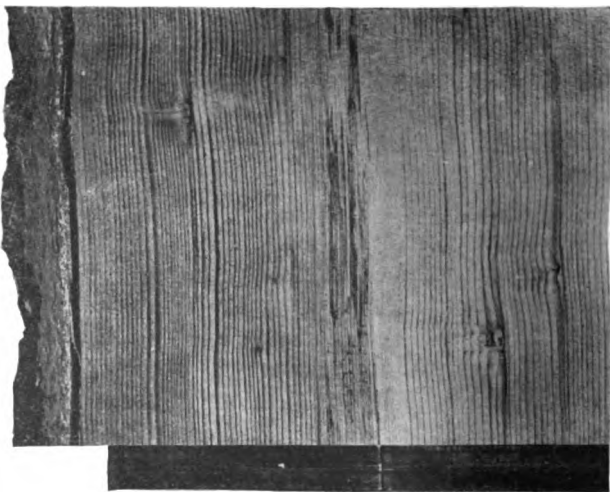


FIG. 15.—Effects of sapsucker work on wood of red fir (*Abies magnifica*). Checks, stains, gnarled and curled grain.

Sapsucker work in willows is difficult to identify, both because the pecks in the bark are quickly effaced and because the appearance of the defects in the wood is so often complicated by adventitious buds. The usual appearances in the wood are small light stains and nipple-like projections over the healed wounds and consequent outward curling of the grain of many layers of wood (fig. 16). However, the checks and stains may be large and black (fig. 17), and extensive light stain may permeate the wood in all directions from the original wound. The checks are sometimes filled with softer, lighter-colored wood, and when adventitious buds develop they increase the distortion of the grain and sometimes form true knots. Willow wood is little used in the United States, but the distortion of the grain caused by sapsuckers by no means improves it for any purpose.

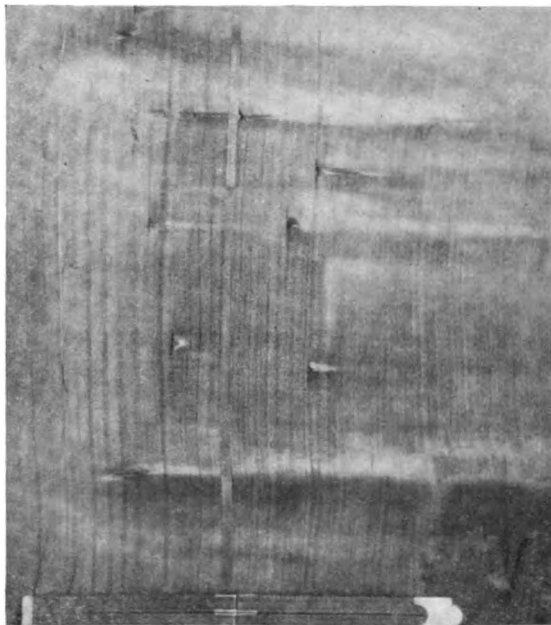


FIG. 16.—Effects of sapsucker work on wood of black cottonwood (*Populus trichocarpa*). Checks, stains, buried adventitious buds, and curled grain.

#### SPECIES OF SALICACEÆ BLEMISHED.—

Silver poplar (H.), swamp poplar, black cottonwood (fig. 16), balm of Gilead, tamarac (A. A.), Carolina poplar (A. M.) (fig. 17), *Salix longipes*, *S. laevigata* (A. A.), *S. toumeyi* (A. A.), *S.*

*amygdaloides*, *S. lasiandra*, *S. interior*, *S. sessilifolia*, *S. missouriensis*, *S. lasiolepis*, *S. hookeriana*, *S. taxifolia* (A. A.), *S. sitchensis*, *S. discolor*, and *S. scouleriana*.

#### THE BAYBERRIES (MYRICACEÆ).

Defects due to sapsucker pecking have been noted in three of the four native arborescent species of this family—the bayberry, wax myrtle, and California bayberry. The blemishes vary from small brown checks to large open ones and black stains up to 2 or 3 inches square, but on account of the limited use made of the wood they are of economic significance in but one species, the California bayberry, which is used in cabinet work and turnery.

## THE WALNUTS AND HICKORIES (JUGLANDACEÆ).

The trees of this family furnish the most costly woods produced in the United States. They are frequently attacked by sapsuckers and the resulting injuries are severe and often ruin the lumber, except for fuel or heavy construction. Serious defects have been observed in the wood of 12 of the 19 native species, and probably all of them are subject to sapsucker injury. In black (fig. 18) and in Texan walnut, the defects consist of heavy black stains running far along the grain and black checks, either filled with loose plugs or open and knotty. They spoil the ornamental appearance of these woods.



FIG. 17.—Effects of sapsucker work on wood of Carolina poplar (*Populus deltoides*). Large checks and gnarled grain.

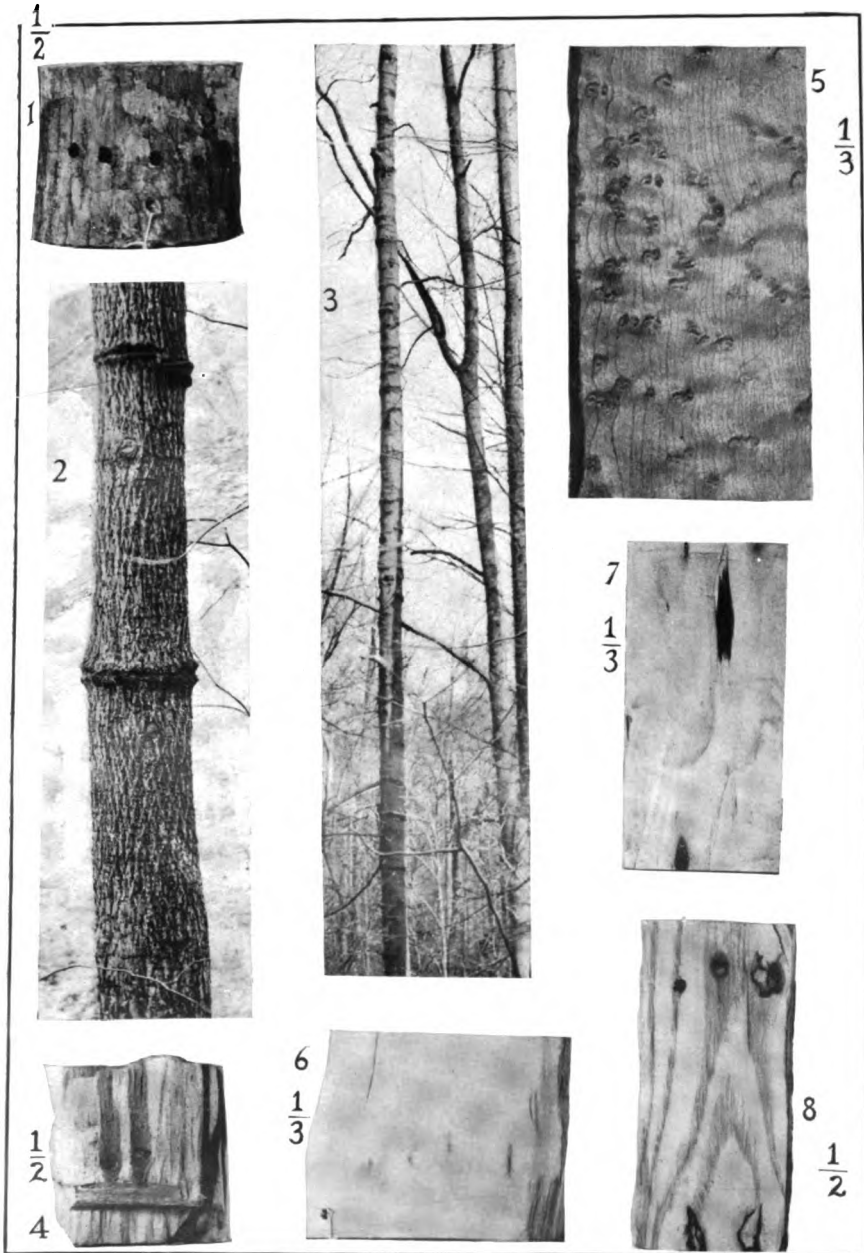
In hickory (Pl. X, figs. 2 to 4, and Pl. XI, fig. 1) the blemishes consist of open black checks (varying in size up to 2 by 4 inches), sometimes soft walled or partly filled with spongy growth, frequently connected with gnarly fissures up to 2 inches in length, which usually extend toward the bark. These are surrounded by brown or black stains called iron streaks, which penetrate more or less wood adjoining the wound and follow the grain sometimes for many feet. They are serious in all the species examined. Mr. Carlos G. Bates of the Forest Service says: "The hickory is oftentimes damaged beyond the effect of the streak. As the wound made by the bird heals over, a small lump is formed over the spot, and stimulated to hypertrophied growth (by the lack of pressure where the bark has been removed). This in time becomes a sort of tubercle standing out at right angles to the stem and protruding through the bark. Sooner or later it ceases to grow, and the normal growth of the tree buries it, leaving a flaw in the wood equal to a large, loose knot."

The abundance and extensiveness of stains and gnarly growth in hickory unfit the wood for ornamental purposes, and the fact that the iron streaks make the wood harder to work and that checking takes place readily along them, spoils the wood for many of its most important uses. "The wood is heavy, hard, very strong, tough,

In hickory (Pl. X, figs. 2 to 4, and Pl. XI, fig. 1) the blemishes consist of open black checks (varying in size up to 2 by 4 inches), sometimes soft walled or partly filled with spongy growth, frequently connected with gnarly fissures up to 2 inches in length, which usually extend toward the bark. These are surrounded by brown or black stains called iron streaks, which penetrate more or less wood adjoining the wound and follow the grain sometimes for many feet. They are serious in all the species examined. Mr. Carlos G. Bates of the



FIG. 18.—Effects of sapsucker work on wood of black walnut (*Juglans nigra*). Holes and dark stains. (From Hopkins.)



**WORK OF SAPSUCKER ON HICKORY, MAPLE, BASSWOOD, AND CHESTNUT; BIRD'S-EYE.**

[1, The beginnings of a girdle on mocker nut. 2, Well-developed girdles, tree 2 feet in diameter. 3, Mocker nut, killed by sapsuckers. 4, Sapsucker pecks and stains in sugar maple wood. 5, Natural bird's-eye in sugar maple. 6, Sapsucker bird's-eye in same wood. 7, Stains due to sapsucker pecking in basswood. 8, Stained knotty checks in chestnut.]



flexible, but not durable in contact with the soil. It is used extensively in the manufacture of carriages and agricultural implements and for ax and tool handles. There is in consequence a good demand for the lumber at a high price."<sup>1</sup> "It is the general impression of the hickory users, . . . that the supply is rapidly diminishing. It is certain that the high grades of hickory required for vehicle parts and for other purposes are being obtained only with increasing difficulty. The average value per thousand feet reported for the lumber is exceeded by only one of the 29 leading species manufactured, namely, walnut."<sup>2</sup> Defects in hickory caused by sapsuckers are specifically mentioned in the Inspection Rules of the Hardwood Manufacturers' Association, where it is stated that the third grade of material is "to consist of the light-weight wood . . . and will admit of small bird pecks, black streaks, and small knots." Hickory wagon and implement stock must be clear with the exception of axles, single and double trees, and neck yokes, "which will admit bird pecks, streaks, and solid knots that will not impair the strength of the piece." A loss of about \$20 per thousand feet of lumber is caused by the reduction in grade on account of bird pecks, and the aggregate loss is very large on account of the prevalence of sapsucker work on hickories throughout their ranges. On Plummers Island, Md., 10 of the 34 hickory trees on a certain area bore sapsucker work, and on another area not far distant on the mainland 38 out of 156, a little more than 25 per cent.

Not only do bird pecks occur on a considerable percentage of hickory trees, but they are characteristically abundant on individual trees. Many trees are ringed from top to bottom by sapsucker work, and not infrequently trees are considerably distorted by large girdles.

Mr. A. T. Boisen, formerly of the Forest Service, writes as follows:

The most serious injury to which the hickories are liable is that known as the "bird peck." . . . The damage done in this way is very extensive, and an immense amount of wood, perhaps as much as 10 per cent of the merchantable material, is left in the woods on account of bird pecks.<sup>3</sup>

Mr. Carlos G. Bates, of the Forest Service, says:

The damage done by the sapsucker is immense, and may amount to 30 per cent of the total value of the hickories in some localities, and for the entire United States at least 10 per cent.

On the basis of the percentages given by Messrs. Boisen and Bates (and according to the writer's experience their estimates are conservative) the loss to hickory producers of the United States on hickory left standing on account of bird pecks amounts to about \$600,000 per year. To this must be added the loss sustained by the producer

<sup>1</sup> Circular 62, Forest Service, p. 2, 1906.

<sup>2</sup> Lumber Cut of the United States in 1907, Bureau of Census, p. 33, 1908.

<sup>3</sup> See also Boisen, A. T., and Newlin, J. A., Bull. 80, Forest Service, p. 32, 1910.

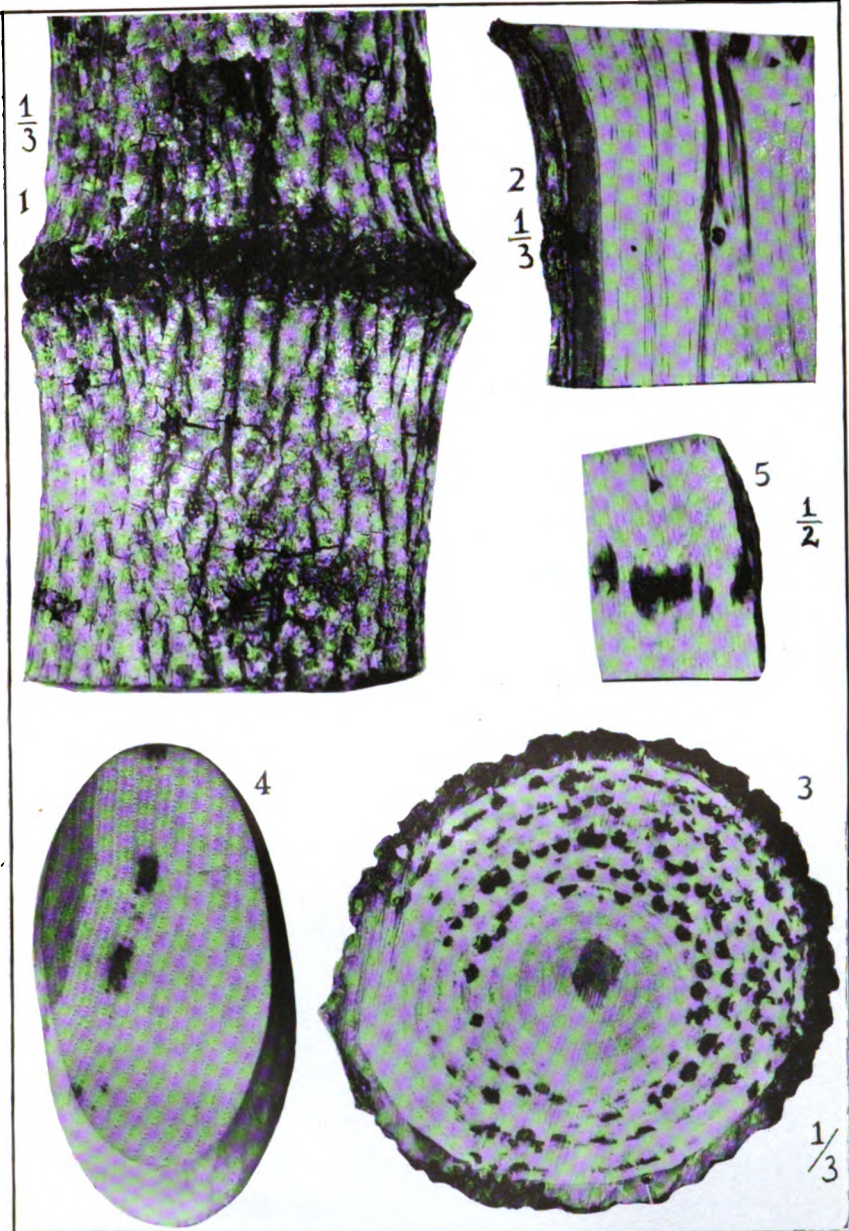
or lumber dealer on the cut timber graded out by the manufacturers' requirements in regard to bird pecks. The writer has been told of a case where 4½ cords of hickory timber were rejected from a lot of 7 cords by this inspection. Finally, in spite of all the care exercised by the manufacturer to secure perfect stock, bird pecks unnoticed before appear in the finished product (see Pl. XI, fig. 1). In the case of handles at least, this is true of quite a noticeable proportion of the output. Mr. H. A. Tatem, president of the Winston Handle Co., Winston-Salem, N. C., writes as follows:

No matter how good the handle, a bird peck generally puts it way below cost. There are many high-class handles with a very slight peck, but down they go. . . . There is no trouble in disposing of them, because they are splendid value for the cost to the consumer. The peck does not injure the handle itself, it is simply defective in appearance.

While we can not agree with the statement that a bird peck never injures a handle, yet our correspondent goes straight to the root of the trouble not only with bird pecks in hickory but in many other woods. Market values depend on appearance more than on quality. However, in the case of hickory the injury is real enough. The gnarly growth caused by the healing of sapsucker wounds is exceedingly objectionable in lumber prized above all things for its straight, clear grain and flexibility. This gnarled condition, as well as the iron streaks which make the quality of the wood fibers uneven, lowers the value of the handles because of the tendency of the grain to rough up or splinter. A member of the Forest Service has stated to the writer that this trouble more than any other would lead him to grade out bird-pecked handles. Uneven quality of the grain is watched for very closely in handles purchased for the Forest Service.

**MOCKER NUT** (*Ilicoria alba*).—Specimens were collected in Fairfax County, Va., March 21, 1909, from a tree bearing abundant sapsucker work, including several conspicuous swollen girdles (Pl. X, fig. 1). It is clear that the sapsucker when attacking this species punctures one or more layers of sapwood. The excavations do not heal perfectly, but persist as small cavities with radiating fissures, all very darkly stained. A cross section through the tree at the level of one of the protruding girdles (Pl. X, fig. 3) shows many concentric series of stains, evidence that the ring of punctures had been pecked open year after year. Longitudinal sections show the usual appearance of these stains in hickory lumber (Pl. X, fig. 2)—namely, very dark iron streaks up to an inch in width, which extend a foot or more both up and down along the grain. The wood shows a distinct tendency to check or split along the course of the stains.

In a specimen of mocker nut from Cloverdale, Ind., the iron streaks extend through from 10 to 12 annual rings of wood, and checks from the wounds have required the deposition of from 5 to 6 annual rings



WORK OF SAPSUCKER ON HICKORY AND OAK.

[1, Near view of a swollen girdle on mockernut, 2, Radial section through a girdle showing iron streaks. 3, Cross section; checks and iron streaks. 4, Same defects on butt of an ax handle. 5, Stains produced by sapsucker pecking in western white oak.]



to close them. The unusual extent of the stains in this sample suggests that they spread after complete closure of the sapsucker wound, and the specimen gives actual evidence that they do so spread for at least two years after the original peck is entirely healed.

The defects in mocker nut are very conspicuous and objectionable. J. B. Burris, of Cloverdale, Ind., who sent in the last specimen described, writes: "Recently a large sale of the timber was made, but on account of the condition of the trees they were refused as being worthless for lumber. The discolorations . . . sometimes run entirely through the length of a tree, though frequently the lower portion of the tree is free from the markings. . . . Upon inquiry I find that in some localities more than half the hickory trees are affected in this way and thus rendered worthless except for firewood." (Dec. 9, 1901.)

**SPECIES OF JUGLANDACEÆ BLEMISHED.**—Black walnut (H.), Texan walnut, nutmeg hickory, pecan (fig. 19), Texan pecan, bitter pecan, bitternut (A. A. and A. M. and F.), mocker nut, big shellbark (H.) (fig. 20), southern shellbark, pignut, and woolly pignut.

**THE HORNBEAMS AND BIRCHES (BETULACEÆ).**

Blemishes in the wood of trees of this family are usually small, consisting of brown stains and sound brown to black checks. In some cases, especially since curly grain and bird's-eye are often present, the effect is ornamental (fig. 21), but probably ornaments as well as defects are of no economic importance in the hornbeams. No serious defects have been found in the birches.

**SPECIES OF BETULACEÆ BLEMISHED.**—Hornbeam (H. and A. A.) (fig. 21), hop hornbeams (*Ostrya virginiana* and *Ostrya knowltoni*), canoe birch, and sweet birch (according to Dr. Hopkins).

**THE BEECHES, CHESTNUTS, AND OAKS (FAGACEÆ).**

The woods of this family are more widely used than those of any other deciduous trees. They are valuable for general construction, cooperage, interior finish, and cabinetmaking, for which purposes



FIG. 19.—Effects of sapsucker work on wood of pecan (*Hicoria pecan*). Knotty checks and iron streaks.

the wood must be sound, and for the latter two uses have few blemishes. Many of the species are attacked by sapsuckers, and the resulting defects in the wood are serious. Defects have been found



FIG. 20.—Effects of sapsucker work on wood of big shellbark (*Hicoria laciniosa*). Stains and gnarly growth. (From Hopkins.)

in the beech, chestnut, and chinquapin, and in all they are detrimental to the appearance of the wood, and in small pieces they diminish the strength. Ornamental curled grain is sometimes produced in beech, but black cavities and extensive brown stain also are formed, which counterbalance the good effect of the desirable grain. In chinquapin and chestnut (fig. 22 and Pl. IX, fig. 8) large open checks result from sapsucker work, which seriously blemish and weaken the wood.

In oak, sapsucker blemishes or bird pecks are almost invariably open knotty checks, sometimes small but usually half an inch square or larger. The checks and the immediately adjoining wood are usually heavily stained and the checks are sometimes partly filled or surrounded by loose soft or rotten wood. The wood over the defects is more or less stained and distorted. Checking through the blemishes commonly occurs, and the weakening of the wood is further shown by the tendency of wind-shakes to occur along the line of sapsucker injuries. Defects have been observed in the wood of 19 oaks, in 17 of which they are serious enough to cause marked loss in value of woods so prized for furniture, interior finish, and other ornamental uses, and in 2 of which, black oak (fig. 23) and cow oak (fig. 24), they are so large as to spoil the wood for any but the coarsest construction. The large, open, knotty checks so characteristic of sapsucker work

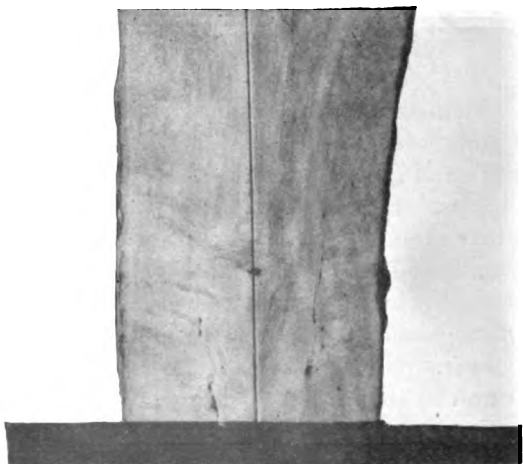
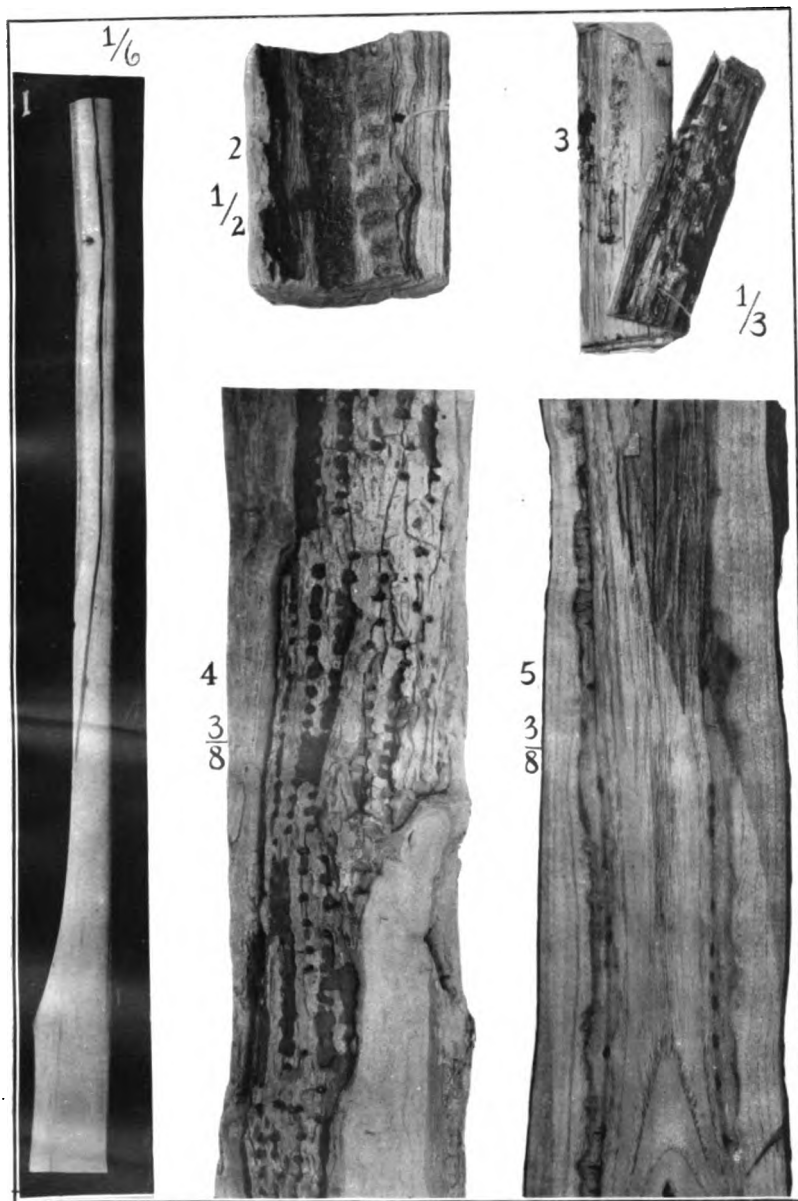


FIG. 21.—Effects of sapsucker work on wood of hornbeam (*Carpinus caroliniana*). Small checks and stains.



WORK OF SAPSUCKER ON HICKORY, PITCH PINE, RED CEDAR, AND SASSAFRAS.

[1, Checks and iron streak in hickory handle. 2, Stains and resin deposit in pitch pine. 3, Stain, resin deposit, and tubercles in red cedar. 4, Sassafras, partly killed by sapsucker pecking and healing over. 5, Longitudinal section of same; checks and stains.]



in oak (present in specimens of 14 of the 19 species examined) effectually spoil the wood for tight cooperage, one of its most valuable uses.

White-oak lumber is extensively used for ornamental purposes and yields the largest returns when so used. It is very carefully graded, and the inspection rules of the National Hardwood Lumber Association specify that "stains and streaks in oak are a serious defect, and inspectors are cautioned to be careful in estimating their damage to pieces, as oftentimes they will reduce them below the grade of firsts and seconds." Reduction in grade means the loss of about 30 per cent from the best selling price. A great deal of white oak is cut into veneers for finishing purposes, and knots and stains are very objectionable. At a veneer plant in Winston Salem, N. C., visited by the writer, all the material showing sapsucker work was found among the lowest grade or cull stuff. Although the cause of the defects was unknown to the millmen, it was evident that blemishes due to sapsucker work are incompatible with high quality in white-oak veneer.

**BEECH** (*Fagus grandifolia*).—A piece of this wood which is not large enough to include the original wounds shows a distinct curl in the wood. The bark has healed with a strong inward projection, which has produced a depression in each new wood layer. The original sapsucker holes were from a fourth to half an inch apart, but the ridge on the inner side of the bark is continuous, with slightly elevated tubercles under the punctures. In such a case, if the sapsucker work is old and many annual rings have been curled, so that the stains can be avoided in sawing the wood, the effect of the bird's work is to enhance the value of the wood for ornamental purposes. However, unless these conditions are met, ornamental features do not mitigate the effect of certain blemishes that are produced. Gnarly growth takes place at the original wound, which is only partly filled and is surrounded by very black stain. A lighter brown stain also extends some distance along the grain. These blemishes are so decided that they would certainly be cause for lowering one or more grades the lumber cut from this tree. (Specimens from Morgantown, W. Va.)

**CHESTNUT** (*Castanea dentata*).—Sapsucker work in chestnut produces large (three-fourths by one-fourth inch) cavities, black stained, and partly filled by loose, black, knotty growth (fig. 22 and Pl. IX, fig. 8.) The wood is weakened by these cavities, as is shown by its

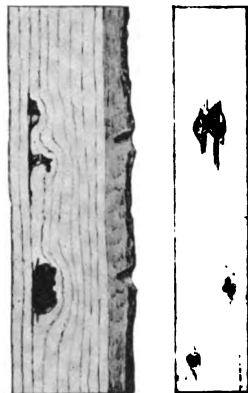


FIG. 22.—Effects of sapsucker work on wood of chestnut (*Castanea dentata*). Large gnarly checks. (From Hopkins.)

checking on a line with them. For cabinet or other work requiring sightliness, or where strength is required in any but large pieces, chestnut with abundant sapsucker work would be useless. (Specimens from Pickens, W. Va.)

**BLACK OAK (*Quercus velutina*).**—The defects produced in this tree

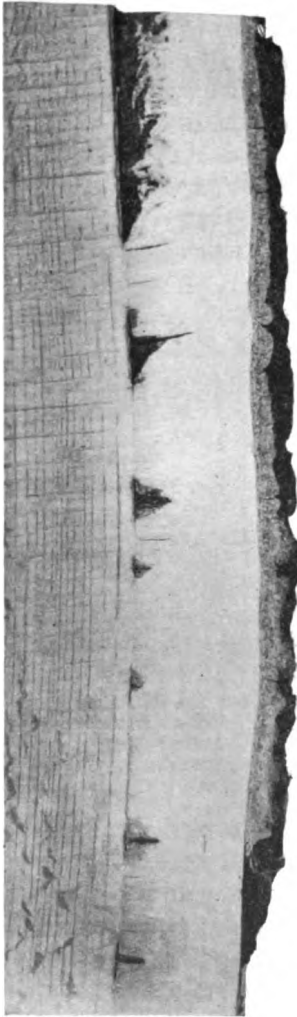


FIG. 23.—Effects of sapsucker work on wood of black oak (*Quercus velutina*). Large gnarly checks.

by sapsucker pecking are large, widely open, black-walled checks surrounded by much gnarled and stained wood (fig. 23). These checks vary in size up to 1 by  $\frac{1}{2}$  by 5 inches and constitute defects so extreme that the lumber is useless for any structural purpose. (Specimens from Abbeville, La.)

**COW OAK (*Quercus michauxi*).**—The defects produced in this wood are large to very large black gnarly checks. These are sometimes contiguous, forming a stained crack following an annual ring (fig. 24), 4 inches horizontally and 2 to 3 inches vertically. Open fissures extending toward the bark and surrounded by much gnarly wood are characteristic. The wood under the wounds is usually soft and rotten. The specimens examined show that wind-shakes tend to occur along the line of sapsucker defects. The blemishes are large and numerous, hence serious. Many wind-fallen trees examined by the writer at Abbeville, La., were so filled with defects that they would not afford a single board of marketable dimensions. The wood is useless except for fuel.

**COLORADO WHITE OAK (*Quercus leptophylla*).**—Numerous open knotty checks stained dark brown occur in a trunk of this species attacked by sapsuckers. They are surrounded by gnarly wood, and some are one-half inch by 1 inch in size, being equivalent to open knots of those dimensions. When several occur along the same

wood layer they constitute a line of potential fracture, thus rendering the trunk more liable to injury by wind-shake. (A. A. and A. M. 301.)

**SPECIES OF FAGACEÆ BLEMISHED.**—Beech, chinquapin, chestnut, tanbark oak, turkey oak, black oak (fig. 23), Texan oak, Spanish oak,

water oak (Santee Club, South Carolina), laurel oak, white live oak (fig. 25), live oak (Santee Club, South Carolina; Glen Rose, Tex., fig. 26), net-leaf oak (A. A.), Texan white oak, shin oak (fig. 27), Chapman oak, chestnut oak (Seven Locks, Md.), cow oak (fig. 24), western white oak (Pl. X, fig. 5), Colorado white oak, post oak (Longbridge, La.), and white oak (H.).

THE ELS AND HACKBERRIES  
(ULMACEÆ).

Defects due to sapsuckers have been noted in the wood of six kinds of elms (including water elm), in three of which they are serious, and in two species of hackberry, one of which is much blemished. The defects vary from light brown stains of no economic significance to black checks, sometimes large and often filled with loose or soft woody tissue.

All of the elms furnish wood of commercial importance, and sapsucker work reduces its value or spoils it for such representative uses as the wooden parts of agricultural implements and vehicles, cooperage, and furniture. Hackberry wood is sometimes used for furniture, for which sapsucker defects unfit it.

**WHITE ELM** (*Ulmus americana*).—Healed sapsucker wounds in this tree vary from small cavities partly filled with powdery tissue to large open knots, sometimes an inch or more in length and involving three to four annual layers of wood (Pl. VIII, fig. 2). These knots,

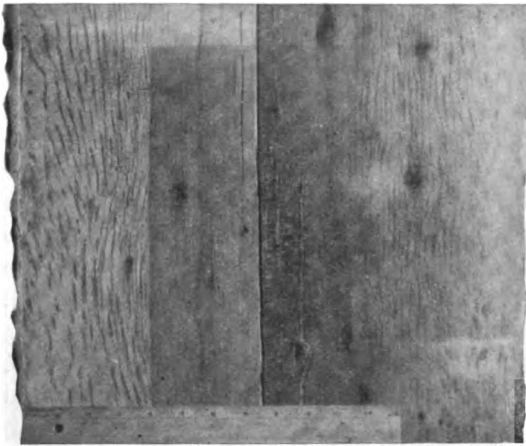


FIG. 25.—Effects of sapsucker work on wood of white live oak (*Quercus chrysolepis*). Knotty checks.

as well as the wood immediately surrounding them, and sometimes for some distance along the grain, are black stained. When sapsucker work is abundant, the whole body of the wood is sprinkled



FIG. 24.—Effects of sapsucker work on wood of cow oak (*Quercus michauxii*). Stained and soft-walled checks.

with stains, the grain is gnarled and in some cases (Pl. VIII, fig. 1) strongly bent outward, and the wood is unfit for any of the ordinary uses of the lumber except fuel or coarse construction. (Specimens from near Scotts Run, Fairfax County, Va.)

**SLIPPERY ELM** (*Ulmus fulva*).—The defects resulting from moderate sapsucker work are short (one-fourth to one-half inch) wavy checks surrounded by black stain extending up to one-half inch both vertically and horizontally on the surface of the wounded annual ring, and by light brown stain for a much greater distance. The stains penetrate the wood under the wounds. Where several pecks are close together, the defects are much worse, being open knotty checks up to  $1\frac{1}{2}$  square inches and with open fissures extending one-half inch or more toward the bark (fig. 28). These large defects are stained black and are surrounded by brown stain extending 4 inches or more. The grain is curled over the pecks. The blemishes seriously affect both strength and beauty. (Specimens from Longbridge, La.) A trunk from Missouri (A. M., 278) contains small black checks and brown stains resulting from sapsucker work.



FIG. 26.—Effects of sapsucker work on wood of live oak (*Quercus virginiana*). Loose knots and stain.

**HACKBERRY** (*Celtis mississippiensis*).—Healed sapsucker punctures in this species appear as transverse dark brown stains from which lighter brown stains run several inches both up and down the grain, and from which also open checks, more or less filled with easily removable soft tissue, extend toward the bark for varying distances up to an inch (fig. 29). These checks are from one-fourth to one-half inch wide. The defects injure the lumber in both appearance and strength. (Cottonport, La., Feb. 14, 1910.)

**SPECIES OF ULMACEÆ BLEMISHED.**—Rock elm, winged elm, white elm, slippery elm, water elm (A. M.), *Celtis occidentalis* (F.), and *Celtis mississippiensis*.

#### THE FOUR O'CLOCK FAMILY (NYCTAGINACEÆ).

The wood of blolly (*Torrubia longifolia*), the only native tree of this family, is sometimes blemished by small open knotty checks with little stain but much gnarly grain.

## THE MAGNOLIA FAMILY (MAGNOLIACEÆ).

Small, intensely black stains, the effects of which are confined to the wood immediately adjoining the original injury, result from sapsucker work in bull bay (Longbridge, La.), the only defective magnolia wood examined; and long black stains following the grain are produced in the tulip tree, one of the most useful of our native trees. These blemishes unfit the lumber for its most profitable uses.

TULIP TREE, YELLOW POPLAR, OR WHITEWOOD (*Liriodendron tulipifera*).—Tulip trees are very commonly worked on by sapsuckers and frequently are covered with girdles and single punctures from top to bottom. In the healing of sapsucker wounds, inward projections are usually formed on the inner side of the bark, and when close together they combine into a low irregular ridge. These elevations cause depressions in the succeeding annual rings and a curly condition of the grain which in tangential section appears as bird's-eye (Pl. XII). This is often abundant in yellow poplar and enhances the beauty of the wood. Bird's-eye is, however, accompanied by holes and stains resulting from the original wounds, and while some pieces showing bird's-eye and not the defects can be secured from every tree showing sapsucker work, probably the proportion of such boards or veneer from any tree is not large. To have the greater part of the wood ornamented and at the same time free from sapsucker defects would require that the tree be liberally punctured in one or a few successive years and left untouched thereafter. But this is not the way sapsuckers usually work. Favorite trees are moderately pecked year after year for a long time; hence stains are produced throughout the wood. If a tree is only sparingly pecked for one or a few years, the ornamental effects will be inconsiderable, and if vigorously attacked during a similar period it is likely to die. On the whole, therefore, probably not many tulip trees can be found in which the wood shows many of the favorable results of sapsucker



FIG. 27.—Effects of sapsucker work on wood of shin oak (*Quercus undulata*). Checks, stain, and gnarly grain.

work and few of the accompanying blemishes. The matter is of no consequence in wood intended for crates, boxes, and composition boards. But tulip lumber figures extensively as a finishing material, often being stained to imitate mahogany. The writer has gone over much tulip veneer, and can state with confidence that the percentage of material showing blemishes from sapsucker work is considerable.



FIG. 28.—Effects of sapsucker work on wood of slippery elm (*Ulmus fulva*). Large check and stains.

#### THE PAWPAWS AND POND APPLES (ANONACEE).

A large sapsucker peck in the wood of one specimen (A. M.) of pawpaw is not healed but is filled with an intensely black deposit.

#### THE LAUREL FAMILY (LAURACEE).

The three species of this family in the wood of which blemishes due to sapsuckers have been noted are all seriously affected. The defects observed in the three species have little in common except a tendency to extensive lateral staining around the injured wood rings.

**RED BAY** (*Persea borbonia*).—A large proportion of red bay trees are vigorously attacked by sapsuckers, and the resulting blemishes are severe. Gnarly open cavities are produced, accompanied by dark brown or black stains which extend far along the grain and are sometimes contin-

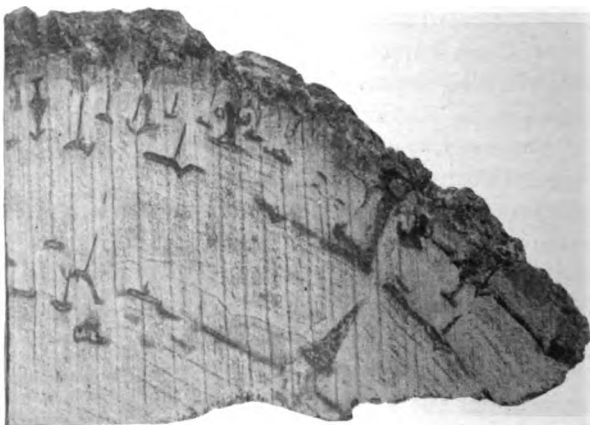
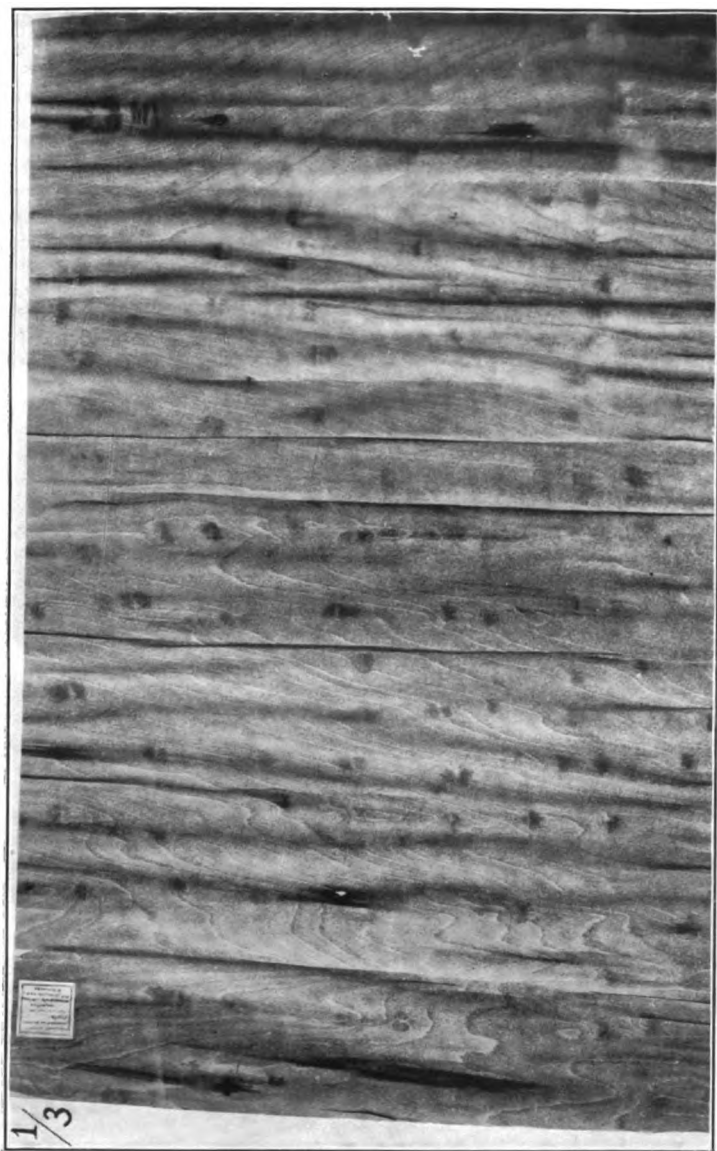


FIG. 29.—Effects of sapsucker work on wood of hackberry (*Celtis mississippiensis*). Stains and loosely filled checks.

uous around the wood rings (fig. 30). Many of the wounds take 15 to 20 years to heal, producing open fissures extending outward an inch or more. These fissures may be half an inch long vertically



WORK OF SAPSUCKER ON TULIP TREE.  
[Stains and bird's-eye.]

1/3



and are walled by soft wood. The stains are heavy and may penetrate one or two layers of wood beneath and five to ten or more layers over the wounds. These defects are exceedingly objectionable and unfit the wood for its limited use in carpentry.

**SASSAFRAS** (*Sassafras variifolium*).—The specimen examined is from a tree one side of which had been killed by sapsucker pecking and is now partly covered by new growth. As the wounds themselves have not healed, their appearance where buried by succeeding layers of wood is unusual. Along the plane of separation of the new and dead wood are long series of partly filled blackened pecks, with stain all along the line (Pl. XI, fig. 5). The wood covering the pecks is gnarled and full of stained cracks and is worthless for any constructive purpose.

**CALIFORNIA LAUREL** (*Umbellularia californica*). — Defects resulting from sapsucker work are conspicuous black checks ac-

companied by extensive lateral staining and much gnarly wood. They are highly objectionable in this valuable wood.

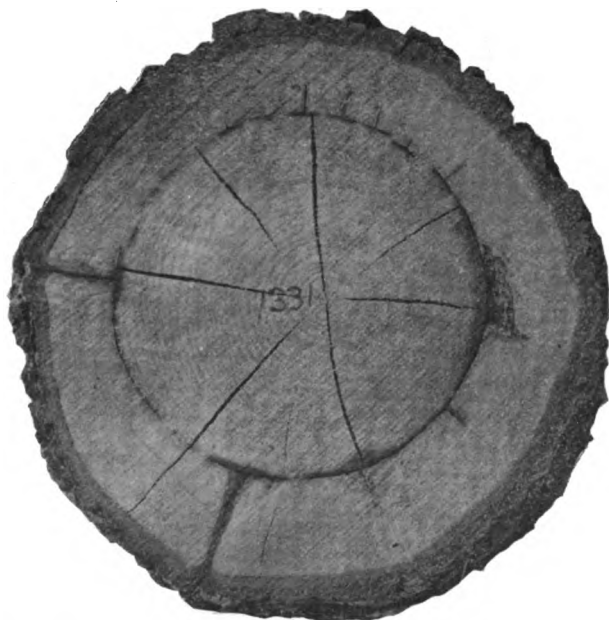


FIG. 30.—Effects of sapsucker work on wood of red bay (*Persea borbonia*). Stains, checks, and long fissures.

#### THE SWEET GUM FAMILY (ALTINGIACEÆ).

The wood of the single native species of this family is injured by sapsuckers.

**SWEET GUM** (*Liquidambar styraciflua*).—In a specimen from Abbeville, La., transverse black stains three-eighths inch wide surround the healed punctures, from which brown stains penetrate the grain vertically half an inch each way. These blemishes are objectionable from an ornamental standpoint but not materially so otherwise. In a trunk from the Santee Club, South Carolina, besides stains which

are peculiar in that they lie mostly in the two to three layers of wood beneath the wounds, more or less open checks are formed, varying in size up to half an inch square and filled with the white crystallized sap. These blemishes are numerous and seriously decrease the usefulness of the lumber. The wood is valuable, often being substituted for black walnut.

#### THE SYCAMORES (PLATANACEÆ).

Defects due to sapsucker pecking have been observed in the wood of two (*Platanus occidentalis* and *P. racemosa*) of the three native sycamores. They are small brown checks and stains and are of no economic importance.

#### THE ROSE FAMILY (ROSACEÆ).

The few arborescent species of this family are not highly valued for their wood, but are used to a small extent for turned articles. The defects produced by sapsuckers, varying from small to large open knotty checks heavily stained, unfit them for this use.

**MOUNTAIN MAHOGANY** (*Cercocarpus ledifolius*).—Sapsucker punctures produce very serious blemishes in the wood—open, knotty, black-walled cavities, some with crystalline sap deposit. Some of these are fully an inch long, and in many cases a large black fissure extends from them toward or even entirely to the bark, through many annual layers of wood. The lumber is ruined as to both beauty and strength (Eureka, Cal., A. A. 202).

**SPECIES OF ROSACEÆ BLEMISHED.**—*Vauquelinia californica*, *Cercocarpus betuloides*, *C. breviflorus*, and *C. ledifolius*.

#### THE APPLE FAMILY (MALACEÆ).

Wood of the trees of this family is usually hard and tough and is used to a small extent for mallets, tool handles, and turnery. The defects produced by sapsuckers, when pronounced, make it useless for such purposes, as they increase liability to splitting. They vary from small brown or black stains to large open checks and fissures.

**CALIFORNIA HOLLY** (*Heteromeles arbutifolia*).—Trunks of this species collected in California (A. A. and A. M. 235) contain conspicuous defects due to sapsuckers (fig. 31). These are large knotty cavities, deeply stained and surrounded by much gnarly growth, with long fissures partly or wholly filled with black-stained or white soft growth extending toward the bark. These checks or fissures sometimes exceed an inch in length. The wood is so distorted and blemished as to be useless except for fuel.

**SPECIES OF MALACEÆ BLEMISHED.**—*Malus angustifolia* (A. M.), *Malus diversifolia*, California holly, *Crataegus crusgalli*, *C. lacrimata*,

*C. opima*, *C. berlandieri*, *C. boyntoni*, *C. collina*, *C. texana*, *C. mollis*, and *C. marshalli*.

#### THE PLUM FAMILY (AMYGDALACEÆ).

Defects caused by sapsuckers have been observed in the wood of seven species of this family. Not all these species have great economic value, but the wild black cherry furnishes one of our most costly woods. The blemishes in it are typical of those in this family, and they are sometimes so serious as to ruin the wood for any ornamental use.

**WILD BLACK CHERRY** (*Padus serotina*).—In specimens from southern Arizona (A. A. and A. M. 188) sapsucker defects vary from small to large black checks accompanied by little stain. Specimens from Randolph County, W. Va. (H. 6801a), show large stains up to 1½ inches long and varying from yellowish brown to black about the healed wounds.

The injuries evidently do not heal readily, as cavities surrounded by gnarly growth are formed. Defects in cherry, which is used almost exclusively for ornamental purposes, are very objectionable. Such

as are here described would certainly lower the grade of lumber, causing a loss of perhaps 75 per cent from the best selling price.

**SPECIES OF AMYGDALACEÆ BLEMISHED.**—Hog plum, wild goose plum, garden plum (F.), bitter cherry, western chokecherry, wild black cherry, and islay.

#### THE SENNA FAMILY (CÆSALPINACEÆ).

Blemishes caused by sapsuckers have been noted in but one species of this family—the honey locust.

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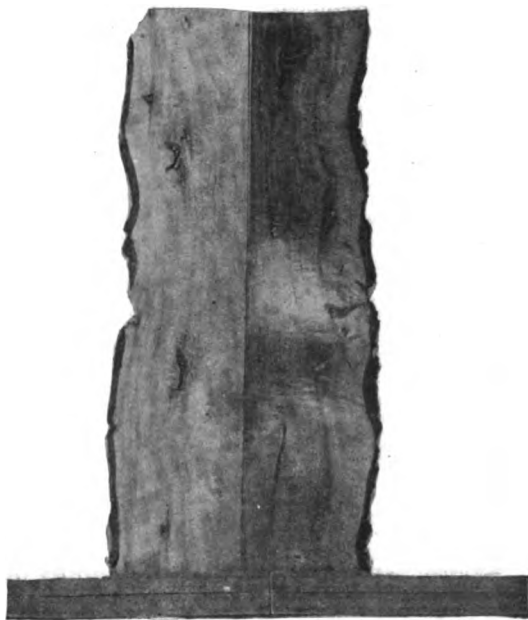


FIG. 31.—Effects of sapsucker work on wood of California holly. (*Heteromeles arbutifolia*). Knotty checks, gnarly grain, stain, and long fissure.

**HONEY LOCUST (*Gleditsia triacanthos*).**—Brown stains penetrating the injured wood layer are developed at the healed wounds, and they are often continuous around the annual ring. In such a case the layer constitutes a potential line of fracture. Many stains are accompanied by open fissures extending outward. These defects are occasionally enlarged by much subsequent pecking until large, ramifying, open, black-stained cavities result. The exterior of the tree is disfigured by large swollen girdles, and the wood in the girdles is gnarled and so full of checks and stains (figs. 32 and 33) that it is useless, except for fuel.

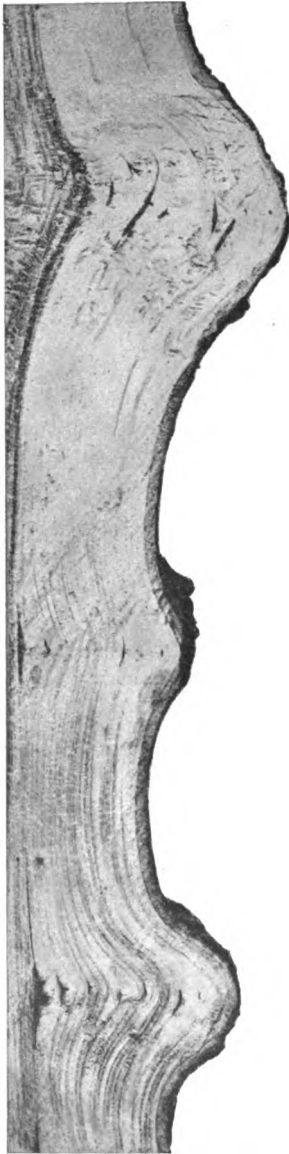


FIG. 32.—Effects of sapsucker work on wood of honey locust (*Gleditsia triacanthos*). Longitudinal section. Checks, stains, and gnarly grain.

#### THE RUE FAMILY (RUTACEÆ).

But one species of this family is known to be injured by sapsuckers, but it is the valuable satinwood (*Xanthoxylum flavum*), which is largely used for furniture and tool handles. Objectionable long dark stains are produced.

#### THE MAHOGANY FAMILY (MELIACEÆ).

The single native species of this family, mahogany, a cabinet wood of the highest value, is seriously blemished by sapsuckers.

**MAHOGANY (*Swietenia mahagani*).**—The wood is heavily stained around the original wounds and a lighter stain extends to a considerable depth and far along the grain. Cavities partly filled with brittle black material are formed, and gnarly growth characterizes the wood in the immediate vicinity of the wounds. Curly wood and a large bird's-eye are present in many annual rings succeeding the injury. Both defects and ornaments are produced in this wood, but to get the benefit of the latter the logs must be sawn with reference to the sapsucker work. As this is not practicable commercially, the blemishes probably overbalance the embellishments.

## THE SUMAC FAMILY (ANACARDIACEÆ).

The wood of one native and one introduced species of this family is blemished by sapsuckers. The matter is of no economic importance except possibly in the case of the introduced pepper tree. Mr. W. Otto Emerson, of Haywards, Cal., contributes the following note on this species: "I have two old pepper trees beside the house where [the red-breasted sapsucker] has left his marks from year to year. In time this cutting of the bark of the pepper tree causes an enlargement of the limb all around where the holes are; the same occurs in the blue-gum tree, and ruins the wood for commercial purposes."

SPECIES OF ANACARDIACEÆ BLEMISHED.—Smoke tree and pepper tree.

## THE HOLLY FAMILY (AQUIFOLIACEÆ).

The wood of three species of holly is known to be blemished by sapsuckers. In two of them greenish brown to black checks and pronounced stains spoil the appearance of the wood for pyrography,

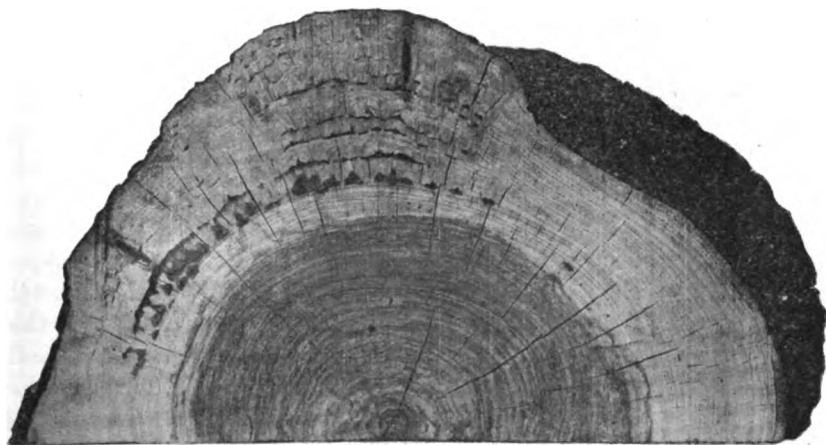


FIG. 33.—Honey locust. Cross section through a girdle. Checks, stains, and gnarly grain. The two long elliptical black marks are nail holes.

one of its most important uses. The checks and fissures produced are objectionable in holly wood used for turnery, because they render it liable to splitting.

HOLLY (*Ilex cassine*).—Healed sapsucker wounds in this wood are marked by large black stains which tend to be continuous around the injured wood ring. Fissures extend outward from the old pecks, some being open, although three-fourths of an inch of wood has formed outside the punctured layer. These fissures are soft-walled and cause much distortion in the surrounding wood. (Fig. 34.) The defects are very serious and render the wood useless except for fuel (Longbridge, La.).

SPECIES OF AQUIFOLIACEÆ BLEMISHED.—Youpon, *Ilex opaca* (Abbeville, La.), and *Ilex cassine*.

## THE MAPLE FAMILY (ACERACEÆ).

Defects due to sapsuckers have been observed in the wood of five species of maples, in three of which they are objectionable and may cause lowering of the grade of lumber. The defects vary from small to large brown stains, sometimes accompanied by long lighter stains and by ornamental curled grain and bird's-eye (figs. 9 and 10 and Pl. IX, figs. 4 and 6). They have been fully discussed in one species, the sugar maple, on pages 58-61.

SPECIES OF ACERACEÆ BLEMISHED.—*Acer rubrum* (A. M. and F.), *A. drummondii*, sugar maple, black maple, and box elder (Fairfax County, Va., and Longbridge, La.).



FIG. 34.—Effects of sapsucker work on wood of holly (*Ilex cassine*).  
Stains and soft-walled fissures.

## THE BUCKEYE FAMILY (ÆSCULACEÆ).

One species is known to be markedly blemished.

OHIO BUCKEYE (*Æsculus glabra*).—A sample of bird-pecked buckeye shows a large stain, and the wound has not been closed by a year's growth. This indicates that conspicuous defects result from sapsucker work in this wood. Buckeye has not long been put to important

uses, but its easy working qualities and beauty are sure to create a greater demand for it. It is even now largely used for pyrography, for which no stained wood can be sold.

## THE BUCKTHORN FAMILY (RHAMNACEÆ).

In the wood of two small trees of this family sapsuckers are known to produce defects varying from small dark brown stains to large stains and knotty cavities. The woods have no commercial importance.

SPECIES OF RHAMNACEÆ BLEMISHED.—*Cascara sagrada* and California lilac.

## THE BASSWOOD FAMILY (TILIACEÆ).

Defects consisting of large open checks and black stains (Pl. IX, fig. 7), due to sapsucker pecking, have been observed in the wood of

three species of this family. They are serious in all, and either lower the grade of the lumber or spoil it for all uses except fuel.

Basswood, often called whitewood, is used for panel work, woodenware, trunks, and other purposes where whiteness is desirable. The inspection rules of the National Hardwood Lumber Association particularly note that "black spots or streaks are a serious defect and inspectors must be careful in estimating their damage. If they are excessive they will reduce the piece one or more grades." Furthermore, a great deal of basswood lumber is used for pyrographic material, in which no stains are permissible. Thus sapsucker work in basswood trees that are to be converted into lumber keeps the product out of the best grades. A loss of about 25 per cent results for each grade the lumber is reduced.

In some localities basswoods are favorite trees of the sapsuckers, as for instance on Plummers Island, Md., where three out of five are attacked. In Rockfish Valley, Va., also, the writer noted a large proportion of basswood barrel



FIG. 35.—Effects of sapsucker work on wood of basswood (*Tilia pubescens*). Stain and extensive gnarly checks.

heads showing sapsucker defects. It is possible therefore that losses due to bird pecks in basswood may at times be heavy.

**BASSWOOD** (*Tilia pubescens*).—In samples from Abbeville, La. (fig. 35), black stains impregnate the punctured wood ring and are so extensive as usually to be contiguous around it; they extend an inch in each direction vertically from the wound. Large open black-stained checks result, some extending toward the bark through several annual rings. These defects are very serious and no good lumber could be sawn from a trunk so defective.

**SPECIES OF TILIACEÆ BLEMISHED.**—*Tilia americana* (H. and F.) (Pl. IX, fig. 7), *T. michauxii*, and *T. pubescens*.

#### THE FREMONTIA FAMILY (CHEIRANTHODENDRACEÆ).

The wood of the single native species (*Fremontodendron californicum*) is blemished by small black checks up to half an inch in length.

## THE WHITE MANGROVE FAMILY (COMBRETACEÆ).

Defects due to sapsucker punctures are known in two of the three native species of this family. In the buttonwood (A. A.) the blemishes are small brown to black checks with short reddish streaks in the wood. In the black olive tree the sapsucker holes are drilled deep into the sapwood, and are either healed by the intrusion of long plugs from the overlying new wood layer or remain open. These defects may be accompanied by more or less dark stain. The wood of this tree is valued for construction, but it is doubtful whether much loss results from bird pecks.

## THE MYRTLE FAMILY (MYRTACEÆ).

W. Otto Emerson, of Haywards, Cal., states that the cutting of the bark of the blue gum (*Eucalyptus globulus*), an introduced tree of this family, by the red-breasted sapsucker in time causes an enlargement of the limb all around and ruins the wood for commercial purposes.



## THE DOGWOOD FAMILY (CORNACEÆ).

FIG. 36.—Effects of sapsucker work on wood of flowering dogwood (*Cynoxylon floridum*). Large stains and gnarly grain.

Blemishes produced by sapsuckers have been noted in the wood of three species of this family, in one of which, the flowering dogwood, they are very objectionable.

**FLOWERING DOGWOOD** (*Cynoxylon floridum*).—The stains are from dark reddish brown to black and are extensive, sometimes forming a continuous band half an inch wide around the annual rings (fig. 36). The wood is strongly bent outward over the healed wood and is very gnarly. The defects are sufficient to keep the wood out of the market, as only perfect pieces are used for such purposes as turnery, carving, and engraving. (Specimens from Cottonport, La.)

**SPECIES OF CORNACEÆ BLEMISHED.**—Tupelo gum, cornel, and flowering dogwood.

## THE HEATH FAMILY (ERICACEÆ).

The wood of two species of this family is known to be blemished by sapsuckers, the defects varying from small to very large stained checks. The woods are, however, little used.

SPECIES OF ERICACEÆ BLEMISHED.—Sourwood and madrona.

THE HUCKLEBERRY  
FAMILY (VACCINIA-  
CEÆ).

The single native arborescent species is badly blemished by sapsuckers.

TREE HUCKLEBERRY (*Batodendron arboreum*).—A moderate amount of sapsucker work in this wood results in very dark brown stains, which run far along the grain and in open checks up to an inch in length. Under vigorous sapsucker attack patches of bark are killed, and the healing being slow the exterior of the tree is considerably distorted by swollen girdles and disfigured by pits and exposed patches of deadwood or bark. The wounds are marked by deep black stains or often by open checks. The latter extend toward the bark and many of them have remained 10 years unhealed (fig. 37). These checks are soft-walled, irregular, and black-stained, and the unclosed ones show patches of dead and discolored wood or bark up to 2½ inches in diameter. These blemishes make the wood useless for any but the coarsest construction or for fuel. (Specimens from Cottonport and Longbridge, La.)

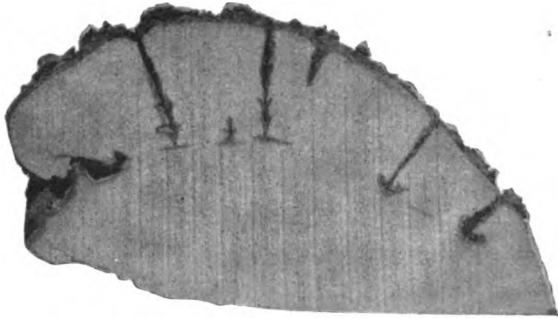


FIG. 37.—Effects of sapsucker work on wood of the tree huckleberry (*Batodendron arboreum*). Longitudinal and cross sections. Stained open checks and fissures.

## THE SAPODILLA FAMILY (SAPOTACEÆ).

The wood of two species of this family, the southern and Arizona buckthorns, is known to be affected by sapsucker work. The checks are small and round and much curled grain overlies the healed wounds; hence the effect is to embellish the wood.

## THE EBONY FAMILY (EBENACEÆ).

One of the two native trees of this family is known to be blemished by sapsuckers. The defects in persimmon are oblong deep black stains, not extending along the grain. They mar the appearance of the wood, but do not injure it for its ordinary commercial uses (Cottonport, La.).

## THE OLIVE FAMILY (OLEACEÆ).

Defects due to sapsuckers have been observed in three species of this family, one of which is the unutilized devilwood, the other two being ashes, both valuable timber trees.

Some of the original wounds in ash persist as cavities only partly filled with loose woody tissue surrounded by conspicuous stains. These blemishes would lower the grade of ash wood, as it is especially prized for its usual freedom from blemishes. In ash lumber used for vehicles and for wooden parts of agricultural implements and machinery, strength is the prime requisite; but for such purposes pieces containing the small open knots resulting from sapsucker work would have to be discarded. Ash is used also for paneling and ornamental purposes. Both blemishes and ornaments appear in the samples examined, but the presence of a few small ornaments by no means prevents the rejection or degrading of a piece for defects. Occurring together, as they always do, the blemishes, which we do not want, overbalance the ornaments, which we can do without.

WHITE ASH (*Fraxinus americana*).—The defects in a specimen from Cottonport, La., are knotty checks surrounded by oblong brown stains. Lighter stains extend along the grain 6 inches or more. Curled grain and bird's-eye are abundant, but being associated with the defects have no importance. In samples of white ash from Abbeville, La., the stains tend to be continuous around the annual rings and penetrate one or two wood layers both over and under the wounded one. More or less open checks remain, some containing loose woody tissue, and the surrounding wood is quite gnarled. These defects are objectionable from an ornamental standpoint and also as to strength in the case of small pieces.

Two specimens of shovel handles are at hand showing the appearance of sapsucker defects in articles manufactured of white ash. One, obtained at Evansville, Ind. (II.), shows scars left by seven of a

series of sapsucker pecks. The bird evidently had drilled through one and in places two layers of sapwood, and the resulting cavities were partly filled by invaginations of wood from the succeeding annual ring. Each of these invaginated plugs is split and gnarly. The wood surrounding the partly filled holes is stained through from two to four annual rings. The other handle, from Marion, Ind., contains small black slightly open checks with light stains extending some distance along the grain. Only checks are present, but the handle had been placed in the lowest grade.

**SPECIES OF OLEACEÆ BLEMISHED.**—Black ash, white ash, and devilwood (A. A.).

#### THE TRUMPET CREEPER FAMILY (BIGNONIACEÆ).

Two trees of this family are slightly blemished by small brown stains and checks due to sapsucker pecking, but the injury is probably of no economic importance.

**SPECIES OF BIGNONIACEÆ BLEMISHED.**—Hardy catalpa (A. A. and A. M.) and desert willow.

#### THE HONEYSUCKLE FAMILY (CAPRIFOLIACEÆ).

Blemishes varying from small black checks to large open knotty black cavities due to sapsuckers have been noted in the wood of two trees of this family.

**SPECIES OF CAPRIFOLIACEÆ BLEMISHED.**—*Viburnum lentago* (A. A.) and *V. prunifolium*.

### SUMMARY OF BLEMISHES AND ORNAMENTAL EFFECTS IN LUMBER RESULTING FROM SAPSUCKER WORK.

The embellishments, sapsucker bird's-eye and curly grain, present to some extent in practically all the wood samples described, while attractive and possibly available for use on a small scale, are usually not marked enough to be of commercial importance. Furthermore, they are invariably accompanied by defects which in most cases rob them of practical value and frequently so disfigure or weaken the wood as to lower seriously or even destroy its market value.

It has been shown that sapsucker work unfits for use such important ornamental woods as mahogany, black walnut, white oak, yellow poplar (*Liriodendron*), chestnut, cherry, sweet gum, and hard maple; that it seriously blemishes woods prized for particular qualities, such as ash, basswood, red cedar, holly, buckeye, dogwood, and hickory, in the case of the latter causing an annual loss of more than half a million dollars; and that sapsucker work sometimes destroys the value of wood even for heavy construction, as in southern basswood, Engelmann spruce, and western hemlock. In all, defects due to sapsucker work have been found in the wood of 174 species of trees.

In 90 of these they are so serious as to spoil the appearance or workability of the wood, and in 22 species they render the wood useless except for coarse construction or for fuel.

Except in the case of hickory, there are not at hand sufficient data to determine the proportion of trees injured by sapsuckers, and hence it is not possible to estimate the actual loss. To remedy this defect in part, the writer has made inventories of the trees of certain areas. Near the mouth of Scotts Run, Fairfax County, Va., an area was marked out and found to contain 55 trees. Ten of these, or 18.1 per cent of the whole number, showed sapsucker work. Of 266 trees on a part of Plummers Island, Md., 36, or 13.5 per cent, have been attacked by sapsuckers. In the west half of the Department of Agriculture grounds at Washington are 232 trees, of which 56, or 24 per cent of the whole, show sapsucker work. The results of less definite observations in the field are as follows: On St. Vincent Island, Fla., only enough live oaks and long-leaf pines are pecked to make 1 per cent of the whole number of trees, but at the Santee Club, South Carolina, 90 per cent of these two species are attacked, as also enough other trees to make the proportion of the whole well over 50 per cent. At Abbeville, La., and Gainesville, Fla., 25 to 60 per cent of the trees in various forests are punctured; at Cottonport, La., about 60 per cent show plentiful pecking, and at Longbridge, La., fully 95 per cent of the trees are profusely drilled, there being only one species, the tupelo gum, on which no pecks were seen. In connection with these estimates it must be borne in mind that we get a record only of the trees which bear considerable sapsucker work, as those with only a few pecks are likely to be unnoted.

In collections of wood specimens in museums, where few if any cases of sapsucker work were overlooked, the following proportions of punctured specimens were noted: One hundred and fifty-one out of a total of about 500, or 30 per cent of those in the American Museum of Natural History, and 71 out of about the same number, or 14 per cent of the specimens in the Arnold Arboretum, Jamaica Plain, Mass., which are mainly smaller pieces of the trees at the American Museum. The difference in size of the samples probably accounts for the discrepancy in the number bearing punctures. The collection of Illinois woods in the Field Museum of Natural History, Chicago, is composed of 197 pieces, of which 36, or 18 per cent, bear sapsucker work. Sixteen out of 64, or 25 per cent, of other United States woods in the same museum were pecked. In the writer's opinion it is safe to assume that at least 10 per cent of the trees in the normal range of the yellow-bellied woodpecker bear marks of its work. This means that the wood of 10 per cent of the trees contains defects.

It has been shown that much white-oak and yellow-poplar veneer and many ash and hickory handles are relegated to the cull grade on account of bird pecks. In hundreds of barrels inspected by the

writer in Virginia about 10 per cent of the basswood barrel heads and of the oak staves bore defects sufficient to cause their rejection from the much more valuable furniture or tight cooperage grades. It has been shown, furthermore, that from 16 to 39 per cent of the wood of individual trees, of bald cypress at least, is spoiled by defects due to sapsucker work. However, if only 1 per cent of the lumber of trees attacked (10 per cent of the whole number) is discarded, the annual loss for the whole United States is more than a million and a quarter dollars. It seems certain that this estimate is not excessive, since it takes no account of lumber not rejected but reduced in grade, and since it has practically been demonstrated that the loss on one kind of timber alone, namely hickory, is fully half the sum mentioned. The meaning of these figures will be better understood if one considers that they express the value of five-sevenths the total cut of black walnut in the United States, or very near the value of the total lumber, lath, and shingle production of single States, as Arizona, Colorado, or New Mexico, and considerably more than the value of the lumber produced by any one of nine other States in the Union.<sup>1</sup>

#### DO OTHER SPECIES OF WOODPECKERS SHARE THE SAPSUCKERS' HABITS?

It has always been a mooted question to what extent, if any, other species of woodpeckers tap trees for the sap. Apparently the red-headed woodpecker is occasionally guilty of the act, but cases where it has been detected actually drilling the holes are so few that the habit must be considered exceptional. Mr. C. A. White writes as follows:

Upon the Iowa University campus we have a number of grand old aboriginal oaks, a favorite resort for red-headed woodpeckers (*Melanerpes erythrocephalus*). Among the young and growing trees that have been transplanted upon the campus are some sugar maples (*Acer saccharinum*) the bodies of which are 6 to 8 inches in diameter. Seeing the woodpeckers busily tapping upon them, I examined the trunks and found them perfectly sound, but the birds had pierced many holes of the usual size through the bark and into the cambium layer, where they stopped. The sap was flowing freely from the holes, and, watching the movements of the birds afterwards upon the trees, I became convinced that they were sucking the sap and that they had pecked the holes for the purpose of obtaining it.<sup>2</sup>

A western relative of the red-headed woodpecker has been found doing similar work. Mr. F. Stephens makes the following statement in regard to the California woodpecker (*Melanerpes f. bairdi*):

At one of my camps in the pine region of Smiths Mountain, a family of this species developed the sapsucking habit. I had noticed some fresh holes in the bark of two live oaks, a foot or two from the ground, from which sap was flowing, and later I saw the birds drinking—in one case three were seen drinking at the same time. This is the only instance of the habit in this species that has come under my observation.<sup>3</sup>

<sup>1</sup> All estimates based on Forest Products Report No. 40, Bureau of Census, 1909.

<sup>2</sup> American Naturalist, VII, 496, 1873.

<sup>3</sup> F. Stephens, in Bendire's Life Histories of N. A. Birds, II, 115, 1895.

Joseph Grinnell records the following observation upon the same species of woodpecker:

At Seven Oaks, June 24, 1906, we had been watching a Sierra sapsucker (*Sphyrapicus v. daggetti*) industriously running a line of bark pits around the branch of an alder, when a California woodpecker . . . flew down and drove off the sapsucker . . . then went the rounds of the borings himself, "dipping" from each.<sup>1</sup>

This observation suggests that the other records of species of woodpeckers besides sapsuckers tapping trees should refer only to their purloining sap from punctures made by the latter. Be that as it may, the assertion has frequently been made that some of our woodpeckers, notably the downy and the hairy, mark trees in a fashion almost indistinguishable from that of the sapsucker. Some of the

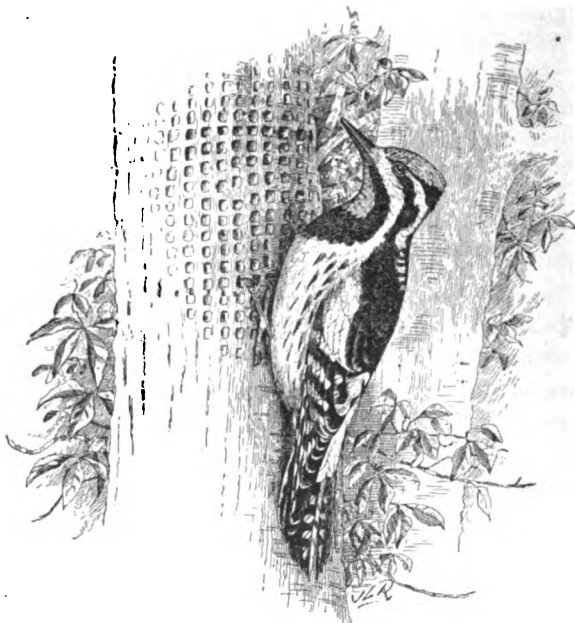


FIG. 38.—Yellow-bellied sapsucker. Note the black spot on breast.

European woodpeckers very closely related to our species of the genus *Dryobates* do a great deal of similar work, even producing large swollen girdles on trees,<sup>2</sup> and it would be surprising if our species were found to be entirely innocent of such practices. Mr. Henry Bryant, of Boston, published the following testimony in 1866:

It has long been known that some of our smaller woodpeckers pick out portions of the sound bark of trees, particularly of apple trees, where there are no

larvæ and apparently no inducement for them to do so. . . . They [the pecks] are generally seen in circles round the limbs or trunks of small irregularly rounded holes, and in this vicinity are made almost exclusively by the downy woodpecker, *P. pubescens*, aided occasionally by the hairy woodpecker, *P. villosus*.<sup>3</sup>

Dr. J. A. Allen corroborates these statements as follows:

The perforations made in the bark of trees by woodpeckers, forming transverse rings, and sometimes so numerous as to do serious injury to the trees, have of late been very commonly attributed almost solely to this species [yellow-bellied woodpecker], especially at the West, where it is so numerous. That it is, from this habit, often greatly injurious to fruit trees is not to be denied; but that this species—now commonly styled the "true sapsucker," to whose depredations it is said should be assigned the

<sup>1</sup> Univ. Calif. Pub. Zool., V, 65-66, 1908.

<sup>2</sup> See Fuchs, Gilbert. Über das Ringeln der Spechte und ihr Verhalten gegen die kleineren Forstschädlinge. Naturwiss. Zeitschr. f. Land u. Forstwirtschaft, III, 317-341, 1905.

<sup>3</sup> Proc. Bost. Soc. Nat. Hist., X, 91-2, 1866.

general ill repute attached to the whole family by most agriculturists—is the sole author of this work, which so often amounts to mischief, there is abundant evidence to disprove. In most parts of Massachusetts, particularly in the Connecticut Valley, this species is so extremely rare that I have never seen more than half a dozen specimens in a year, and oftener none at all, and then always during its migrations; while other expert collectors have searched for it unsuccessfully for years; yet our orchards always present these perforations in profusion, though seldom to an injurious degree; and now and then a forest tree is observed so thoroughly girdled as to be thus destroyed. For this our spotted woodpeckers, *Picus pubescens* and *P. villosus*, are chargeable, being in many sections the sole authors of it; they may be, in fact, very often seen engaged in it. I do not, however, suppose their object to be the same as that assigned to the *Sphyrapicus varius*—that of sucking sap or feeding on the inner bark.<sup>1</sup>

Evidence supporting the same contention is given by Mr. C. K. Reed, who says:

Most of you have probably noticed apple trees that had rows of holes extending around, or nearly around, the trunk. I was always told, and frequently see it in print now, that these were made by sapsuckers. Perhaps some of them are, but not all. Last fall I watched a downy busily at work hammering on the trunk of an apple tree. He would pound away for about half a minute steadily in one spot and then hitch sideways about an inch and repeat the operation; when he had completely encircled the tree he dropped down about his length and made another ring around the trunk. The marks left on the tree were identical with those that I had supposed were made by the sapsuckers. The downy did not appear to find anything to eat, and I concluded that he was doing it in play or that he wished to sharpen his bill.<sup>2</sup>



FIG. 39.—Flicker. Not a sapsucker. Has black spot on breast, but top of head from bill is not red. Has conspicuous white rump.

There is one fallacy included or implied in most of the above quotations, namely, that a profusion of punctures in trees where the sapsuckers are scarce proves that the work was done by other woodpeckers. This by no means follows. In most cases the bulk of the pecking on trees is old; only a moderate number of punctures, as a rule, are made each year, and the amount of fresh work rather than the total should be considered in determining the probable agent. A tree 100 years old—a moderate age—might bear much sapsucker work, even where the birds are very scarce and only a few holes were drilled in it each year. When a great number of punctures are made

<sup>1</sup> Mem. Bost. Soc. Nat. Hist., I, 499, 1869.

<sup>2</sup> Bien. Rep. Commissioner Fish. and Game, Ind., p. 733, 1905-6.

in one season, the tree is likely to be weakened or killed, and not a single instance is on record of any woodpecker in this country, other than a member of the genus *Sphyrapicus*, killing a tree by girdling it. Nor, as a rule, is the work of the hairy and downy woodpecker so much like that of the sapsuckers as not to be distinguishable from it. The writer has observed the downy woodpecker at work in suspicious proximity to fresh drills resembling those made by sapsuckers. But upon examination these were found to go barely through the outer bark and not to the sapwood, as is true of sapsucker holes. Hence



FIG. 40.—California woodpecker. Not a sapsucker. Has black breast spot, but head is not red from base of bill.

the punctures were not injurious. Mr. E. H. Forbush notes<sup>1</sup> that the perforations made by the downy [in red maple] differ from those of the sapsucker; and Weed and Dearborn seem to have had similar experience, as they say of the downy woodpecker: "Although it bores holes in the bark of apple trees, it does not revisit them to suck the sap . . . and the holes seem usually not to injure the tree."<sup>2</sup> Prof. F. E. L. Beal corroborates this, saying that the holes made by this woodpecker reach only to the inner bark and that no protruding girdles or other deformations of the trunk are produced.

A very convincing bit of evidence bearing on this point is given by Dr. T. M. Brewer. He had experience in parts of the country where the sapsucker is not often seen, but where there are many punctured trees, conditions which cause the downy, hairy, and other woodpeckers to be known as sapsuckers and to be persecuted. Upon becoming well acquainted with *Sphyrapicus* also, he wrote as follows:

In April, 1868, I visited gardens in Racine, in company with Dr. Hoy, where these woodpeckers [i. e., sapsuckers] had every successive spring committed their ravages, and was eyewitness to their performance. Their punctures were unlike those of *pubescens* (downy), being much deeper, penetrating the inner bark, and being repeated in close proximity, . . . often resulting in the girdling and complete destruction of a tree. In one garden of some considerable size all the mountain ash and white pine

<sup>1</sup> Useful Birds and their Protection, p. 256-7 [1907].

<sup>2</sup> Weed, C. M., and Dearborn, N., Birds in their Relations to Man, p. 185, 1903.

trees had thus been killed. In prairie countries, where trees are a deficiency and their cultivation both important and attended with difficulty, these birds prove a great pest, and in a few hours may destroy the labor of many years.<sup>1</sup>

Whether or not the downy and other woodpeckers seek sap, it is beyond question that they are not important consumers of cambium, since on the average much less than 1 per cent of this substance has been found in the stomach contents of any other woodpecker than the true sapsuckers (*Sphyrapicus*).<sup>2</sup> It is the loss of cambium rather than of sap that breaks down the vigor of the trees and is responsible for defects in the wood, and to the sapsuckers, which consume cambium to an average extent of 13.8 per cent of their annual food,

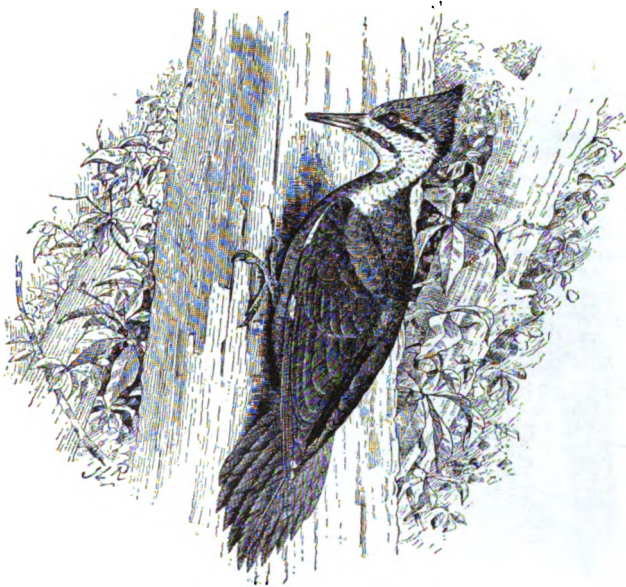


FIG. 41.—Pileated woodpecker. Not a sapsucker. Entire lower parts black.

must be attributed most if not all serious injuries to trees due to the destruction of cambium by woodpeckers.

#### FOOD OF SAPSUCKERS.

About four-fifths of the insect food of the three species of sapsuckers consists of ants, the eating of which may be reckoned slightly in the birds' favor. The remainder of the food is made up of beetles, wasps, and a great variety of other insects, including, however, practically no wood-boring larvæ or other special enemies of trees. The birds' vegetable food can not be cited in their behalf, as it consists almost entirely of wild fruits, which are of no importance, and of

<sup>1</sup> Baird, Brewer, and Ridgway, History of N. A. Birds, Land Birds, II, 542, 1874.

<sup>2</sup> A mere glance at the figures (3 and 4) of the tongues of the yellow-bellied sapsucker and the downy woodpecker must convince anyone that these birds are adapted to the utilization of entirely different food supplies.

cambium, the securing of which results in serious damage, as shown in the preceding pages.

#### HOW TO RECOGNIZE SAPSUCKERS.

Plate I (frontispiece) and Plate II (p. 16) will serve to identify the sapsuckers better than pages of printed descriptions, and therefore only a few marked color differences will be mentioned here. All sapsuckers have yellow bellies, few other woodpeckers have; all sapsuckers have a conspicuous white patch on the upper part of the wing, as seen from the side when clinging to a tree; white wing patches in other woodpeckers are on the middle or lower part of the



FIG. 42.—Hairy woodpecker. Not a sapsucker. No black breast spot.

wings. The yellow-bellied sapsucker of transcontinental range is the only woodpecker having the front of the head (i. e., from bill to crown) red in combination with a black patch on the breast. The red-breasted sapsucker lives west of the Rockies and is the only species there having the whole head and throat red.

From 4 to 11 species of woodpeckers other than sapsuckers occur in various sections of the United States; hence a majority of woodpeckers seen are not sapsuckers. Several of these species are illustrated (figs. 38 to 44), and notes are given on the features distinguishing them from sapsuckers.

#### DEFENSIVE MEASURES AGAINST SAPSUCKERS.

Mr. C. G. Bates says of the eastern bird:

The sapsucker spends only his winters in the hardwood region, and the greatest damage is done on warm winter days and in the spring just before migration. For this reason hickories should not be planted, especially in the South, in situations where they will be started by the first warm days, but rather where their rise of sap will be retarded.

This advice applies to the planting of orchards also, as the risk of damage by frost is lessened by planting on north slopes. It is said that fine wire netting has been used in some localities to protect the trunks of fruit trees, but this is impracticable for large numbers of trees, while advice as to methods of planting does not apply to trees at present subject to sapsucker attack. Good results have been obtained by plastering cow droppings or fish glue around trees where the sapsuckers have worked, and the wounds may be made to heal more readily by cutting out the injured parts and covering with grafting wax.

When preventive measures fail and the extent of the damage warrants it, the birds must be killed. But such extreme measures should be adopted only when orchards or other valuable tree plantations are attacked, and extreme care should be taken to kill only the injurious species.

It does not appear to be difficult to poison sapsuckers. Mr. Ellwood Cooper has kindly furnished details of a method of poisoning used successfully by himself in California, of which the following is the substance: I took about one-half pint of honey and pulverized the crystals of strychnine, using about a

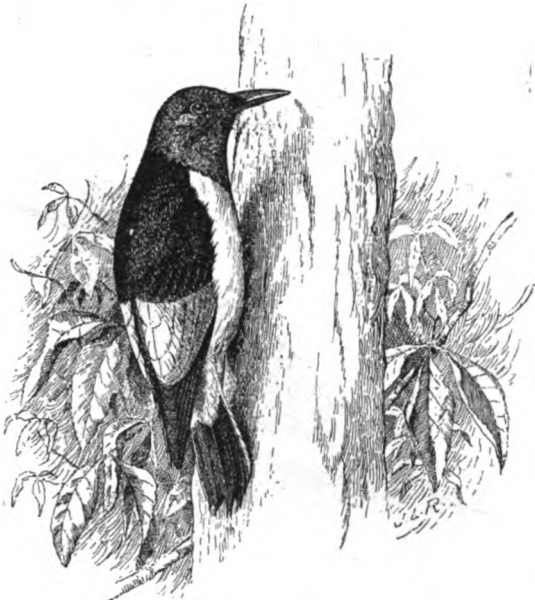


FIG. 43.—Red-headed woodpecker. Not a sapsucker. Has no black spot on breast.

coffeespoonful of the powder and making a thorough mixture. With a wooden paddle I smeared the mixture around the trunk about 2 or 3 inches above the last ring of holes made by the birds. It proved very effective. This method has the advantage of insuring the destruction of the sapsuckers, while the risk of destroying other birds is reduced to a minimum.

The method of poisoning may be stated in more exact terms as follows: Mix thoroughly an eighth of an ounce of powdered strychnine (the alkaloid, which is not easily soluble, and hence will not flavor the

mixture) with 1 pint of honey or other thick sirup. Apply to the injured tree just above the rows of fresh punctures.

A simpler way of poisoning the sapsuckers was discovered by Mr. Ned Dearborn of the Biological Survey. The powdered strychnine (alkaloid) was introduced directly into the fresh sap pits, by means of a bit of straw or grass stem. A very small quantity sufficed for each hole, and the poison remained effective for at least two days. It should be noted here that humming birds and some other small birds, particularly warblers, will be killed by poison intended for sapsuckers. Nevertheless, taking all things into consideration, it seems wise to recommend the use of poison rather than the gun.

### GENERAL CONCLUSIONS.

From an economic standpoint woodpeckers may be divided into two groups:

(1) The woodpeckers proper, which are chiefly beneficial. These slightly damage trees when excavating nests and shelter cavities.



FIG. 44.—Red-bellied woodpecker. Not a sapsucker. No black breast spot.

In some sections they are responsible also for injury to telephone and telegraph poles and for minor damage to houses, barns, fences, and other structures. To minimize this damage the trial of nesting boxes especially designed for woodpeckers is recommended.

Killing the birds should be the last resort. When all is said and done, however, woodpeckers of this group much more than compensate for all the harm they do by devouring large numbers of the insect enemies of trees, many of which are preyed on by no other birds.

(2) Sapsuckers, which are very injurious. The sapsuckers, unlike other woodpeckers, secure a considerable part of their subsistence from the tissues and juices of trees. In doing this they often destroy so much of the cambium or growing layer that the trees are weakened and disfigured or even killed. Further, the wood of many of the trees they attack is so stained and distorted during the healing process that its value for lumber is impaired or destroyed. The loss

from this cause in the United States is more than one and a quarter million dollars annually. Sapsuckers do not prey upon any especially destructive insects and do comparatively little to offset the damage they inflict. Hence the yellow-bellied sapsucker (*Sphyrapicus varius*) and its western variety (*Sphyrapicus v. nuchalis*), the red-breasted sapsucker (*Sphyrapicus ruber*) and its northern form (*Sphyrapicus r. notkensis*) must be included in the class of injurious species, the destruction of which when caught red-handed is justifiable. In certain States it may prove desirable to deny these birds the degree of protection they now enjoy. We know too little at present to decide the status of the Williamson sapsucker (*Sphyrapicus thyroideus*).

As there are 20 species of woodpeckers in the United States and only 2 of them are under indictment, great care should be exercised to distinguish the real offenders. When it is necessary to destroy sapsuckers, poison should be used because of the small risk to other species of birds.

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